

# Module Manual

Bachelor of Science

# General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2016

Updated: 28th September 2018

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# **Module Manual**

Bachelor

# General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2016

Updated: 28th September 2018

## **Program description**

## Content

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



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

#### **Career prospects**

The graduates of the Bachelor program General Engineering Science are directly able to enter a career in the field of mechanical engineering, civil engineering, electrical engineering, process engineering or computer science engineering and work responsibly as engineer. They are entitled to use the professional title Ingenieurin or Ingenieur (Engineer) pursuant to the Engineers Acts (Ingenieurgesetzen) of the states in Germany.

Possible employers include companies in mechanical, civil, process, electrical and computer science engineering as well as engineering firms.

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

#### Learning target

#### Knowledge

Students can:

- · Name and describe the mathematical and scientific principles and methods of the engineering sciences;
- Ellucidate the principles and methods of the engineering sciences and present an overview of their subject;
- Explain in detail the foundations, methods and areas of application of their specialization, and, as necessary, their particular focus;
- Recite the foundations and methods of the engineering sciences and provide an overview of the relevant social, ethical, ecological and economic marginal conditions of their subject.

#### Skills

Graduates are able to

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

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

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

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

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

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

#### **Social Competence**

Graduates are able to



- 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.

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# Core qualification

Module M0701: Ch	emistry (GES)			
Courses				
Title Chemistry (GES) I (L0467) Chemistry (GES) I (L0478) Chemistry (GES) II (L0469) Chemistry (GES) II (L0479)	<b>Typ</b> Lecture Recitation Sect Lecture Recitation Sect		Hrs/wk 2 1 2 1	<b>CP</b> 2 1 2 1
Module Responsible	Dr. Christoph Wutz			
Admission Requirements	None			
Recommended Previous Knowledge	None			
	After taking part successfully, students have reached the followin	g learning	results	
Professional Competence				
Knowledge	The students are able to name and to describe basic principles and applications of general chemistry (structure of matter, periodic table, chemical bonds), physical chemistry (aggregate states, separating processes, thermodynamics, kinetics), inorganic chemistry (acid/base, pH-value, salts, solubility, redox, metals) and organic chemistry (aliphatic hydrocarbons, functional groups, carbonyl compounds, aromates, reaction mechanisms, natural products, synthetic polymers). Furthermore students are able to explain basic chemical terms.			
Skills	After successful completion of this module students are able to describe substance groups 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	120 min			
-	General Engineering Science (English program): Core qualificati General Engineering Science (English program, 7 semester): Co	•	•	ulsory



Course L0467: Chemistry (GES) I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Christoph Wutz	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>Structure of matter</li> <li>Periodic table</li> <li>Electronegativity</li> <li>Chemical bonds</li> <li>Solid compounds and solutions</li> <li>Chemistry of water</li> <li>Chemical reactions and equilibria</li> <li>Acid-base reactions</li> <li>Redox reactions</li> </ul>	
Literature	<ul> <li>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>	

Тур	Recitation Section (large)
Hrs/wk	1
CP	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	ry (GES) II
Тур	Lecture
Hrs/wk	2
CP	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 apllications and examples</li> </ul>
Literature	- Gallagher, Ingram: Complete Chemistry (Oxford University Press) - Corwin: Introductory Chemistry (Pearson) - Burrows, Parsons, Price,Holman: Chemistry3 (Oxford University Press)

Course L0479: Chemisti	urse L0479: Chemistry (GES) II		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	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		



courses				
ïtle		Тур	Hrs/wk	СР
Programming in C (L0083)		Lecture	1	1
Programming in C (L1488)		Practical Course	1	1
Module Responsible				
Admission Requirements	None			
Recommended	Elementary PC handling skills			
	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have	ve reached the following lea	arning results	
Professional Competence				
	The students know by heart the basic synt purpose.	tax of C programming as we	ell as its meaning,	intent and
	They know the fundamental components a based on C programming and can explain		y procedural prog	ramming
Knowledge	<ul> <li>basic data types (integers, floating point</li> <li>advanced data types (pointers, arrays, si</li> <li>operators (arithmetical operations, logica</li> <li>control flow (choice, loops, jumps, conditions)</li> <li>functions and macros</li> <li>important standard libraries and function</li> <li>recursion</li> <li>linked lists</li> </ul>	trings, composed data types al operations, bit operations tional compilation)		)
	The students are prepared for continuing C++.	programming lectures like	e object oriented	programming
	The students know how to use an integrat so that they can write, store, compile and a	•	ent for C programn	ning on a PC
	Using their knowledge they are able to rea	ad and understand given C	Programs.	
	They can solve simple algorithmic problem in C language.	ns on their own and can mo	odel and program	their solution
	The students are able to solve selected ex mechanics, electrical engineering or phys		•	
Personal Competence				
Social Competence	The students are able to work in small tea programming errors and to present their re		sks, 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 programming exercises on their own.	ne given teaching material a	and solve the give	n
	Additionally, they write small C programs to understand and check addressed issues and also to gain a certain programming experience.			
	For details beyond the scope of the lecture literature and / or by supplementary own r		elves using the st	ated
Workload in Hours	Independent Study Time 32, Study Time in	n Lecture 28		
Credit points				



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

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

Course L1488: Program	ourse 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 M0745: Ele	ectrical Engineering I			
Courses				
Title Electrical Engineering I (L06 Electrical Engineering I (L06		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 2	<b>CP</b> 5 1
Module Responsible	Prof. Manfred Kasper			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students know the basic theory, relations and methods of direct current networks and of electric 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>			
Skills	The students are able to establish relations be networks and to apply these to calculate and fundamental laws of electric and magnetic fie between field quantities. Students know to calcul geometric arrangements.	d dimension networks. S Ids and are able to der	tudent know	w to apply the aluate relations
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a group and to present the results accordingly. Students can explain concepts and on the basis of examples verify and deepen their understanding.			
Autonomy	Students are able to acquire particular knowl integrate, present and associate this knowledge to also solve more complicated problems.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points				
	Written exam			
Examination duration and scale	120 minutes			
_	General Engineering Science (English program) General Engineering Science (English program,		-	ulsory



Course L0677: Electrica	I Engineering I
Тур	Lecture
Hrs/wk	
CP	5
Workload in Hours	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 M0736: Lir	near Algebra			
Courses				
<b>Title</b> Linear Algebra (L0642) Linear Algebra (L0643) Linear Algebra (L0645)		<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 4 2 2	<b>CP</b> 4 2 2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in linear algebra. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in linear a course. Moreover, they are capable of solv</li> <li>Students are able to discover and verify studied in the course.</li> <li>For a given problem, the students can der to critically evaluate the results.</li> </ul>	ving them by applying esta y further logical connection	ablished me ons betwee	thods. In the concepts
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 128, Study Time in Lectu	ure 112		
Credit points	8			
Examination	Written exam			
Examination duration and scale	120			
Assignment for the Following Curricula	Computer Science: Core qualification: Compulso General Engineering Science (English program): General Engineering Science (English program,	Core qualification: Comp		ulsory



Course L0642: Linear Al	lgebra
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

Тур	Recitation Section (large)
Hrs/wk	2
CP	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

se L0645: Linear Algebra		
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	NN	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
<b>Fitle</b> Mechanics I (GES) (L1373) Mechanics I (GES) (L1374)		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The primary purpose of the study of Statics is to develop the capacity to predict the effects of forces or rigid bodies, structural elements and simple structures, which are at rest (in equilibrium). Such a capacity is critical to the design of many structural or engineering systems. The particular objectives o this course are to: <ol> <li>Introduce the student to the basic principles required to analyse the effects of forces applied to rigid bodies, structural elements and simple structures in equilibrium;</li> <li>Demonstrate sound techniques of constructing and solving idealised mathematical models o real engineering systems;</li> <li>Promote the analytical and problem-solving skills required to solve a wide variety of rea engineering problems effectively.</li> </ol> </li> </ul>			
Skills	<ol> <li>At the end of this course the student is able to:</li> <li>Apply the properties of two- and three-or elements and simple structures in equilib</li> <li>Isolate a body in equilibrium by drawing body are represented.</li> <li>Analyse the external effects of forces act three-dimensional equilibrium using the</li> <li>Analyse the internal forces in trusses an</li> <li>Solve problems of equilibrium with accound.</li> <li>Determine mass centres and centroids or</li> </ol>	rium. its free-body diagram on w ing on a single body or a s free-body diagram of the bo d beams. Int for dry friction.	hich all forc ystem of bo ody or syste	es acting on tl dies in two- ar
Personal Competence				
Social Competence	Students can: - work in arouns and report on the findings, - develop joint solutions in mixed teams and			
Autonomy	Students are able to: - solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the aid of the mid-term test.			
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	1.5 hours Statics: force systems, equilibrium, ma	ss center, friction, trusses, I	beams.	



Course L1373: Mechanic	es 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>* Thexible cables.</li> <li>* Virtual work principle.</li> </ol>
Literature	<ol> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley &amp; Sons, SI Version, 4<sup>th</sup> Edition.</li> <li>R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3<sup>rd</sup> Edition.</li> </ol>



Course L1374: Mechanic	es I (GES)
Тур	Recitation Section (large)
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	<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>* Virtual work principle.</li> </ol> * Denotes an additional topic.
Literature	<ol> <li>J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley &amp; Sons, SI Version, 4<sup>th</sup> Edition.</li> <li>R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3<sup>rd</sup> Edition.</li> </ol>



Courses				
Title		Тур	Hrs/wk	СР
Physics for Engineers (GES		Lecture	2	3
Physics for Engineers (GES	G) (L0560)	Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Calculus and linear algebra on hig</li> <li>Physics on high school level</li> </ul>	gh school level		
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics such as in the areas of mechanics oscillations, waves, and optics. Students can relate physics topics to technical problems.			
Skills	Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise.			
Personal Competence				
Social Competence	Students can jointly solve subject related within the framework of the problem solvin		esent their re	esults effectivel
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.			
Workload in Hours	Independent Study Time 78, Study Time i	n Lecture 42		
Credit points	4			
Examination	Written exam			
Examination duration and scale	120 min, 10 problems with two parts a) an	d b) plus physics lab attestation		
Assignment for the	General Engineering Science (English pr	ogram): Core gualification: Comp	ulsorv	



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	
CP	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	

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

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	<ul> <li>locate selected specialized areas with the relevant non-technical mother discipline,</li> <li>outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,</li> <li>different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul>
	Professional Competence (Skills)
	In selected sub-areas students can
Skills	<ul> <li>apply basic methods of the said scientific disciplines,</li> <li>auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,</li> <li>to handle simple questions in aforementioned scientific disciplines in a sucsessful manner,</li> <li>justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.</li> </ul>
Personal Competence	
	Personal Competences (Social Skills)
Social Competence	<ul> <li>Students will be able</li> <li>to learn to collaborate in different manner,</li> <li>to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,</li> <li>to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),</li> <li>to explain nontechnical items to auditorium with technical background knowledge.</li> </ul>
	Personal Competences (Self-reliance)
Autonomy	<ul> <li>Students are able in selected areas</li> <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 M0671: Te	chnical Thermodynamics I			
Courses				
<b>Title</b> Technical Thermodynamics Technical Thermodynamics Technical Thermodynamics	I (L0439)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 4 1 1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	none			
Recommended Previous Knowledge	Elementary knowledge in Mathematics and Mecha	anics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students are familiar with the laws of Thermodynamics. They know the relation of the kinds of energy according to 1 <sup>st</sup> law of Thermodynamics and are aware about the limits of energy conversions according to 2 <sup>nd</sup> law of Thermodynamics. They are able to distinguish between state variables and process variables and know the meaning of different state variables like temperature, enthalpy entropy and also the meaning of exergy and anergy. They are able to draw the Carnot cycle in a Thermodynamics related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equations of state. They know the meaning of a fundamental state or equation and know the basics of two phase Thermodynamics.			
Skills	Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and heat for simple change of states and to use this calculations for the Carnot cycle They are able to calculate state variables for an ideal and for a real gas from measured thermal state variables.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop an approach.			
Autonomy	Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice.			knowledge as
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): General Engineering Science (German program, 7 Bioprocess Engineering: Core qualification: Comp Energy and Environmental Engineering: Core qua General Engineering Science (English program): 0 General Engineering Science (English program, 7 Computational Science and Engineering: Speciali Mechanical Engineering: Core qualification: Comp Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification : Compulsory Technomathematics: Specialisation III. Engineering Process Engineering: Core qualification: Compulsor	7 semester): Core qualific oulsory ilification: Compulsory Core qualification: Compu- semester): Core qualifica sation Engineering Scien oulsory g Science: Elective Comp	ation: Comp ulsory ation: Compu ices: Elective	Ilsory



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

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



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



Module M0772: Ele	ectrical Engineering II			
Courses				
Title Electrical Engineering II (L07 Electrical Engineering II (L07		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 2	<b>CP</b> 5 1
Module Responsible	Dr. Helge Fielitz			
Admission Requirements	None			
Recommended Previous Knowledge	Content of the Lecture "Electrical Engineering	I (Elektrotechnik I)"		
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students know the basic theory, relations and methods of time dependent network theory and basic nonlinear circuit elements. This includes, in particular:</li> <li>transients,</li> <li>the use of complex numbers and phasors,</li> <li>the concept of impedance,</li> <li>steady state sinusoidal circuit analysis,</li> <li>complex power and 3-phase systems,</li> <li>transformers,</li> <li>transfer function and filters,</li> <li>the concept of resonance,</li> <li>diodes and rectifiers,</li> <li>bipolar transistors and operational amplifiers</li> </ul>			
Skills	The students are able to establish relations networks. The students know how to apply n filter-like structures, and resonating network elements, such as diodes, bipolar transistors,	etwork theory to analyze 3-ph s. The students know to incl	nase system ude basic r	ns, transformers, nonlinear circuit
Personal Competence				
Social Competence	Students are able to solve specific proble accordingly. Students can explain concepts deepen their understanding.		-	
Autonomy	Students are able to acquire particular kno integrate, present, and associate this knowled also solve more complicated problems.			
Workload in Hours	Independent Study Time 110, Study Time in L	.ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
	General Engineering Science (English progra General Engineering Science (English progra			ulsory



Course L0747: Electrica	I 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>

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

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Module M0737: Ma	thematical Analysis			
Courses				
<b>Title</b> Mathematical Analysis (L06- Mathematical Analysis (L06- Mathematical Analysis (L06-	48)	<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 4 2 2	<b>CP</b> 4 2 2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in analysis. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable o illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in analysis 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				
Autonomy				
Workload in Hours	Independent Study Time 128, Study Time in	Lecture 112		
Credit points	8			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Computer Science: Core qualification: Com General Engineering Science (English prog General Engineering Science (English prog	ram): Core qualification: Comp		ulsory



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

ourse L0648: Mathema	rse L0648: Mathematical Analysis			
Тур	Recitation Section (large)			
Hrs/wk	2			
CP	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			

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		

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Courses				
Title		Тур	Hrs/wk	СР
Mechanics II (GES) (L1417) Mechanics II (GES) (L1418)		Lecture Recitation Section (large)	2 2	3 3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements	None			
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, students have reache	ed the following learning	results	
Professional Competence				
Knowledge	elastic bodies, structural elements and simple structures in equilibrium;			es, which are eering system prces applied
	<ol> <li>Demonstrate sound techniques of constructing and solving idealised mathematical model real engineering systems;</li> <li>Promote the analytical and problem-solving skills required to solve a wide variety of engineering problems effectively.</li> </ol> At the end of this course the student should be able to:			
Skills	<ol> <li>Determine average normal and shear stresses.</li> <li>Determine shear stresses and the angle of twist due to torsion of a circular shaft.</li> <li>Determine thermal stresses in rods.</li> <li>Analyse statically indeterminate rods and shafts</li> </ol>			
Personal Competence				
Social Competence	Students can: work in groups and report on the findings, develop joint solutions in mixed teams and			
Autonomy	Students are able to; - solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the help of the mid-term test.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				
Examination	Written exam			
	1.5 hours Mechanics of Solids: stress and strain due to axial loading, torsion, bending, stres transformation, moments of inertia, buckling, energy methods.			



Course L1417: Mechanic	es II (GES)
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Radoslaw Iwankiewicz
Language	EN
Cycle	SoSe
Content	<ol> <li>COURSE CONTENTS:         <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> </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>th</sup> Edition</li> </ol>

Course L1418: Mechanie	Irse L1418: Mechanics II (GES)				
Тур	Typ Recitation Section (large)				
Hrs/wk	2				
CP	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				

Γ



Module M0594: Fu	ndamentals of Mechanical E	ngineering Design		
Courses				
<b>Title</b> Fundamentals of Mechanica	al Engineering Design (L0258) al Engineering Design (L0259)	<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge		nics and production engineering		
Educational Objectives	After taking part successfully, students	have reached the following learnin	g results	
Professional Competence		able to:		
Knowledge	<ul> <li>explain basic working principles and functions of machine elements,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of basi machine elements, indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solvin skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>technically evaluate basic designs.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss methods.</li> </ul>	technical information in the lect	ure supporte	ed 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 understoo content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Tir	me in Lecture 56		
Credit points				
	Written exam			
Examination duration and scale	120			
Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Тур	Lecture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers		
Language			
Cycle			
	Lecture		
Content	<ul> <li>Introduction to design</li> <li>Introduction to the following machine elements <ul> <li>Screws</li> <li>Shaft-hub joints</li> <li>Rolling contact bearings</li> <li>Welding / adhesive / solder joints</li> <li>Springs</li> <li>Axes &amp; shafts</li> </ul> </li> <li>Presentation of technical objects (technical drawing)</li> </ul>		
	<ul> <li>Exercise</li> <li>Calculation methods for dimensioning the following machine elements: <ul> <li>Screws</li> <li>Shaft-hub joints</li> <li>Rolling contact bearings</li> <li>Welding / adhesive / solder joints</li> <li>Springs</li> <li>Axis &amp; shafts</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, 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., Sprin Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		

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

Γ



Module M0688: Te	chnical Thermodynamics II			
Courses				
Courses		Tue	Hue hele	CD
<b>Title</b> Technical Thermodynamics	II (1 0449)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
Technical Thermodynamics		Recitation Section (large)	1	1
Technical Thermodynamics		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous Knowledge	Elementary knowledge in Mathematics, N	Nechanics and Technical Thermod	ynamics I	
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional				
Competence				
Knowledge	Students are familiar with different cycle processes like Joule, Otto, Diesel, Stirling, Seiliger and Clausius-Rankine. They are able to derive energetic and exergetic efficiencies and know the influence different factors. They know the difference between anti clockwise and clockwise cycles (heat-power cycle, cooling cycle). They have increased knowledge of steam cycles and are able to draw the different cycles in Thermodynamics related diagrams. They know the laws of gas mixtures, especiall of humid air processes and are able to perform simple combustion calculations. They are provider with basic knowledge in gas dynamics and know the definition of the speed of sound and know about a Laval nozzle.			
Skills	Students are able to use thermodynamic laws for the design of technical processes. Especially the are able to formulate energy, exergy- and entropy balances and by this to optimise technical processes. They are able to perform simple safety calculations in regard to an outflowing gas from tank. They are able to transform a verbal formulated message into an abstract formal procedure.			
Personal Competence				
Social Competence	The students are able to discuss in small	groups and develop an approach		
Autonomy	Students are able to define independently tasks, to get new knowledge from existing knowledge a well as to find ways to use the knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	<u> </u>			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



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

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

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

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



## Module M0853: Mathematics III

## Courses

Courses			
Title	Тур	Hrs/wk	СР
Analysis III (L1028)	Lecture	2	2
Analysis III (L1029)	Recitation Section (small)	1	1
Analysis III (L1030)	Recitation Section (large)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Differential Equations) (L1032)	Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1033)	Recitation Section (large)	1	1

Module Responsible	Prof. Anusch Taraz	
Admission Requirements	None	
Recommended Previous Knowledge	Mathematics I + II	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional		
Competence		
Knowledge	<ul> <li>Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>	
Skills	<ul> <li>Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concepts studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>	
Personal Competence		
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as a common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.</li> </ul>	
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.</li> <li>Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.</li> </ul>	
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112	
Credit points		
· · · ·	Written exam	
Examination duration and scale	160  min (Analysis III) + 60  min (Differential Equations 1)	



Assignment for the Following Curricula	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory
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Course L1028: Analysis III		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Main features of differential and integrational calculus of several variables</li> <li>Differential calculus for several variables</li> <li>Mean value theorems and Taylor's theorem</li> <li>Maximum and minimum values</li> <li>Implicit functions</li> <li>Minimization under equality constraints</li> <li>Newton's method for multiple variables</li> <li>Double integrals over general regions</li> <li>Line and surface integrals</li> <li>Theorems of Gauß and Stokes</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	

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



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

Course L1031: Differential Equations 1 (Ordinary Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Main features of the theory and numerical treatment of ordinary differential equations</li> <li>Introduction and elementary methods</li> <li>Exsitence and uniqueness of initial value problems</li> <li>Linear differential equations</li> <li>Stability and qualitative behaviour of the solution</li> <li>Boundary value problems and basic concepts of calculus of variations</li> <li>Eigenvalue problems</li> <li>Numerical methods for the integration of initial and boundary value problems</li> <li>Classification of partial differential equations</li> </ul>	
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>	

Course L1032: Differential Equations 1 (Ordinary Differential Equations)	
Тур	Recitation Section (small)
Hrs/wk	1
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: Different	ourse L1033: Differential Equations 1 (Ordinary Differential Equations)	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses					
<b>Title</b> Mechanics III (GES) (L1421 Mechanics III (GES) (L1420 Machanics III (GES) (L1420	)	<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 2 1	<b>CP</b> 3 2 1	
Mechanics III (GES) (L1419		Recitation Section (large)	I	I	
Admission	Prof. Radoslaw Iwankiewicz				
Requirements	None				
Recommended Previous Knowledge	None				
	After taking part successfully, students have	reached the following learning	results		
Professional Competence	The primary purpose of the study of Mec develop the capacity to predict the effects of of moving machine parts, different machiner etc.The particular objectives of this course ar	forces and motions, necessary y, vehicles, aircraft, spacecraft,	for the ana	ysis and desig	
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>				
	<ul> <li>At the end of this course the student should 1.</li> <li>1. Solve the equilibrium problems with a 2. Analyse stability of simple floating bo</li> <li>3. Calculate the velocity and acceleration of a</li> <li>4. Derive and solve the equation of m</li> </ul>	account for hydrostatic pressure odies. a particle in different reference	systems.	stems.	
	5. Analyse the motion of the system of particles and forces acting on it with the aid of work-energy and impulse-momentum relationships,				
Skills	6. Calculate the instantaneous linear and angular velocities and accelerations of the plana mechanisms.				
	7. Derive and solve the equations of a plane motion of a rigid body and find forces acting on it,				
	8. Apply work-energy and impulse-momentum relationships to analyse plane kinetics of a rigid body.				
	9. Calculate the instantaneous linear and angular velocities and accelerations of the three dimensional motion of a rigid body.				
	10. Derive the equations of a motion of a three-dimensional motion of a rigid body.				
	11. Apply in three-dimensional kinematics a and matrix methods.	nd kinetics of rigid body both	methods o	f vector algeb	
Personal Competence					
Social Competence	Students can: - work in groups and report on present them to others, - assess the team col			nixed teams a	
Autonomy	Students are able to: -solve the problems independently with the help of hints, - assess their own strengths and weaknesses, e.g. with the aid of the mid-term test.				
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84			
Credit points	6				
Examination	Written exam				



 Examination duration
 2 hours Fluid Statics: hydrostatic pressure, buoyancy, stability of floating vessels. Kinematics of particle, of plane and 3D rigid bod,y. Kinetics of particle, system of particles, of plane and 3D rigid body. Vector and matrix algebra formulation. General Engineering Science (English program): Core qualification: Compulsory

Assignment for the<br/>Following CurriculaGeneral Engineering Science (English program): Core qualification: Compulsory<br/>General Engineering Science (English program, 7 semester): Core qualification: Compulsory<br/>Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory

ourse L1421: Mechanics III (GES)	
Тур	Lecture
Hrs/wk	3
CP	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: Mechanics III (GES)	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	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



Course L1419: Mechanic	es III (GES)	
Тур	Recitation Section (large)	
Hrs/wk		
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Radoslaw Iwankiewicz	
Language	EN	
Cycle	WiSe	
Content	<ul> <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> </ul>	
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 M1273: Ad	Ivanced Internship GES		
Courses			
Title	Typ Hrs/wk CP		
Module Responsible	Prof. Gerhard Schmitz		
Admission Requirements	None		
Recommended Previous Knowledge	150 ECTS Credits in General Engineering Science		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students of the different specialisations get experiences in typical scope of duties of engineers, who are working in a development division, planning division or in the management of a company. In the framework of this environment the knowledge from university can used a first time for real engineering tasks.		
Skills	Students of the different specialisations should be integrated in typical day's work. By this they are learning typical tasks and functions of engineers. They are able to structure and organize their working day and to finish tasks in a certain time.		
Personal Competence			
Social Competence	Students are able to cooperate with co-workers in a company and to understand the language o engineers.		
Autonomy	Students can finish own tasks.		
Workload in Hours	Independent Study Time 540, Study Time in Lecture 0		
Credit points	18		
Examination	Written elaboration (accord. to Internship Regulations)		
Examination duration and scale	see Internship Regulations		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory		



## **Specialization Civil Engineering**

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

Module M0580: Pr	inciples of Building Materials and Bu	uilding Physics		
Courses				
<b>Title</b> Building Physics (L0217)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Building Physics (L0219) Building Physics (L0247)		Recitation Section (large) Recitation Section (small)	1 1	1 1
Principles of Building Materia	als (L0215)	Lecture	2	2
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge of physics, chemistry and mathematic	s from school		
Educational Objectives	After taking part successfully, students have reach	ned 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 a very extensive field.	operation steps to learn t	the specialis	st knowledge o
	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points				
	Written exam			
Examination duration and scale	2h			
	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English program): Compulsory General Engineering Science (English progra Compulsory Technomathematics: Specialisation III. Engineerin	nm, 7 semester): Specia fication:Compulsory Specialisation Civil- and I m, 7 semester): Special	lisation Civ Enviromenta lisation Civ	il Engineering I Engeneering



ourse 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	
Literature	Fischer, HM. ; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3	

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

course L0247: Building 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	

Γ



Module M0740: Str	ructural Analysis I			
Courses				
<b>Title</b> Structural Analysis I (L0666) Structural Analysis I (L0667)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanics I, Mathematics I			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
	After successfully completing this module, students can express the basic aspects of linear frame analysis of statically determinate systems.			
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	Students can			
Social Competence	<ul> <li>participate in subject-specific and interdis</li> </ul>	thers eagues	icism	
Autonomy	The students are able work in-term homework enabled to self-assess their learning progress du			dback, they ar
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 Minuten			
	General Engineering Science (German pr Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qual General Engineering Science (English program) Compulsory General Engineering Science (English progra Compulsory Technomathematics: Specialisation III. Engineeri	ification: Compulsory : Specialisation Civil- and am, 7 semester): Specia	lisation Civ Enviromenta lisation Civ	il Engineering al Engeneering



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

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



Courses				
Title		Тур	Hrs/wk	СР
Building Materials and Buildin		Lecture	4	4
Building Materials and Buildi		Recitation Section (sn	nall) 1	2
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Module Principles of Building Materials a	nd Building Physics		
Educational Objectives	After taking part successfully, students ha	ve reached the following lear	ning 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 t select building materials according to their specific advantages and disadvantages. The students ar able to prepare the mixture of a normal type concrete and to consider the mixture in respect to th actual rules and the connections between the characteristic concrete parameters. They are able to select suitable materials and mixtures to avoid damage processes.			
Personal Competence				
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge in learning groups and to carry out exercises in small groups in the lab.			
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	2 stündige Klausur			
Assignment for the Following Curricula				



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

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



Module M0706: Ge	otechnics I			
Courses				
<b>Title</b> Soil Mechanics (L0550)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Soil Mechanics (L1493)		Recitation Section (large) Recitation Section (small)	2 2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	Modules : • Mechanics I-II			
Educational Objectives	After taking part successfully, students have reac	hed 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 Lectu	re 84		
Credit points	6			
	Written exam			
Examination duration and scale	60 Minuten			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory			



Course L0550: Soil Mechanics			
Тур	Typ Lecture		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Jürgen Grabe		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Structure of the soil</li> <li>Ground surveying</li> <li>Compsitition 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

Tvp	Recitation Section (small)
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0613: Re	inforced Concrete I			
Courses				
Title Project Seminar Concrete I Reinforced Concrete Desigr Reinforced Concrete Desigr	n I (L0303)	<b>Typ</b> Seminar Lecture Recitation Section (large)	<b>Hrs/wk</b> 1 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in structural analysis and	building materials.		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	The students can outline the history of concrete construction and explain the basics of structural engineering, including usual load combinations and safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the behaviour of the materials and of structural members.			
Skills	The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions.			
Personal Competence				
Social Competence				
Autonomy	The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the results.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula				



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

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

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

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		_		
Title Structural Analysis II (L0673		<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Structural Analysis II (L0674		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek			
Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mechanics I/II</li> <li>Mathematics I/II</li> <li>Differential Equations I</li> <li>Structural Analysis I</li> </ul>			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence				<i></i>
Knowledge	After successful completion of this module, stud analysis of statically indeterminate systems.			
	After successful completion of this module, the construct influence lines of statically inderminate		•	
Personal Competence				
Social Competence	<ul> <li>Students can</li> <li>participate in subject-specific and interdis</li> <li>defend their own work results in front of ot</li> <li>promote the scientific development of coll</li> <li>Furthermore, they can give and accept pro-</li> </ul>	thers eagues	icism	
Autonomy	The students are able to work in-term homework enabled to self-assess their learning progress du	•		dback, they a
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 Minuten			
Assignment for the	General Engineering Science (German pr Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qual General Engineering Science (English program)	ification: Compulsory	lisation Civ	il Engineerin



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

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

Course L0674: Structural Analysis II		
Тур	Recitation Section (large)	
Hrs/wk	2	
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: Ste	eel Structures I			
Courses				
Title Steel Structures I (L0299) Steel Structures I (L0300)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Structural analysis I, Structural analysis II</li> <li>Mechanics I, Mechanics II</li> <li>Building Materials and Building Chemistry</li> <li>Principles of Building Materials and Building Physics</li> </ul>			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	<ul> <li>After passing this module students are able to</li> <li>give a summary of the security concept</li> <li>explain the priciples of the design process</li> <li>describe and illustrate the bhaviour of memers in tension, compression and bending</li> </ul> Students can rate and apply the material steel appropriately with respect to its properties and usage.			
Skills	They can use the security concept with respect to loads, forces and resistances.			
Personal Competence				
Social Competence	After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be successful in guided building a truss with bolted connections according to design drawings.			
Autonomy				
	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory			



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

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



Module M0728: Hy	draulic Engineering I			
Courses				
Title Hydrology (L0909)		<b>Typ</b> Lecture	<b>Hrs/wk</b> 1	<b>CP</b> 1
Hydrology (L0956)		Project-/problem-based Learning	1	2
Hydromechanics (L0615) Hydromechanics (L0616)		Lecture Recitation Section (large)	2 1	2 1
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I, II and III Mechanik I und II			
Educational Objectives	After taking part successfully, students have rea	ached 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 practica problems. Besides this, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems. In addition, the basic concepts of field – measurements of hydrological and hydrodynamic values car be described and the students are able to perform, analyze and assess respective measurements.			
Personal Competence Social Competence	The students are able to prepare and present technical presentations for given topics in groups.			
Autonomy	Students can provide each other with feedback and suggestions on their results. They are capable o reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points	6			
Examination				
	The duration of the examination is 2 hours. The understanding of the lecture contents and calcu		s with respe	ct to the genera
Assignment for the Following Curricula				



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: <ul> <li>Hydrological cycle</li> <li>Data acquisition</li> <li>Data analyses and statistical assessment</li> <li>Statistics of extremes</li> <li>Regionalization methods for hydrological values</li> </ul> Rainfall-run-off modelling on the basis of a unit hydrograph conceps	
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde	

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



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

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



Module M0628: Wa	ater Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (LC	251)	Lecture	1	1
Groundwater Hydrology (LC	252)	Recitation Section (large)	1	2
Water Management and Wa	ter Quality (L0366)	Lecture	2	3
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Mathemaics I to III; Water Engineering I, Chemistry			
Educational Objectives	After taking part successfully, stude	nts have reached the following learnin	g results	
Professional Competence				
Knowledge	Students are able to define terms of the hydrologic cycle and also parameters to identify the wate 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 th solution of practical issues. They are in a position to rate water quality data and to set up hydrologica 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 othe	r solving case studies.		
Autonomy	Are not imparted in this module.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Elective Compulsory Civil- and Environmental Engineeri	erman program, 7 semester): Spec ng:Core qualification:Compulsory nglish program, 7 semester): Speci		-



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

ourse L0252: Groundw	urse L0252: Groundwater Hydrology		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	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	<ul> <li>The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview:</li> <li>Water balance, water availability, water scarcity, water recycling</li> <li>Water quality parameter (organic, inorganic), assessment and decision support tools.</li> </ul>		
Literature	<ul> <li>Teil Wasserwirtschaft:</li> <li>Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001</li> <li>Wasser; Grohmann, Andreas N Berlin [u.a.]: de Gruyter, 2011</li> <li>Pdf der Vorlesung</li> </ul>		



Courses				
Title	(1005.0)	Тур	Hrs/wk	СР
Introduction to Control Syste Introduction to Control Syste		Lecture Recitation Section (small)	2 2	4 2
-			2	L
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, 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 frequenc response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence		to jointly solve technical problems, a	and experim	nentally valida
Autonomy	their controller designs Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (Ge Compulsory	nan program): Core qualification: Comp rman program, 7 semester): Special nan program, 7 semester): Specialisati	isation Con	

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

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



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

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Module M0631: Co	oncrete Structures II			
Courses				
	Project Concrete Structures II (L0894) Concrete Structures II (L0348)		<b>Hrs/wk</b> 1 2 2	<b>CP</b> 1 3 2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Knowledge of loads on structures and c</li> <li>Basics of safety format are required.</li> <li>Knowledge in design of beams and colution.</li> <li>Lecture 'Concrete Structures I'</li> </ul>			
Educational Objectives	After taking part successfully, students have rea	ached 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 des results at the end.	sign in a team a real concre	te building	and present the
Autonomy				
	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Examination Examination duration and scale	Written exam 120 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective 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: Elective Compulsory			



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

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

Course L0349: Concrete 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: Co	mputer Engineering			
Courses				
Title Computer Engineering (L0321) Computer Engineering (L0324)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
Admission	None			
Requirements				
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the interna structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shal understand the consequences that the execution of software has on the hardware-centric abstractior 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	Chudante ava able te celus cimilar avableme alana			
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly
	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Examination	Written exam			
Examination duration				

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



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

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

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



Module M0755: Ge	otechnics II			
Courses				
<b>Title</b> Foundation Engineering (L05	552)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Foundation Engineering (L05		Recitation Section (large)	2	2
Foundation Engineering (L14	494)	Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	Modules: • Mechanics I-II • Geotechnics I			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	The students know the basic principles and me geotechnical structures.	thods which are required	to verificate	e the stability of
Skills	<ul> <li>After successful completion of the module the students are able to:</li> <li>verificate the stability and usability of foundations,</li> <li>know individual methods of ground improvement and apply them in their range of application,</li> <li>design retaining walls.</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 minutes			
	General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Elective Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English program): Compulsory General Engineering Science (English progra Elective Compulsory Technomathematics: Specialisation III. Engineeri	am, 7 semester): Specia ification: Compulsory Specialisation Civil- and Im, 7 semester): Specia	lisation Civ Enviroment	vil Engineering al Engeneering



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

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

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



# Module M0878: Applications in Civil and Environmental Engineering

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Courses	Lecture22ng (L1903)Lecture11ng (L1904)Project-/problem-based Learning22Structures (L0370)Lecture23			
Title	Тур	Hrs/wk	СР	
Applied Numerical Methods (L0211)	Seminar	3	3	
Applied Structural Dynamics (L0791)	Lecture	2	2	
Building Information Modeling (L1903)	Lecture	1	1	
Building Information Modeling (L1904)	, ,	2	2	
Computational Analysis of Structures (L0370)	Lecture	2	3	
Introduction in Statitics with R (L0286)	Lecture	1	1	
Introduction in Statitics with R (L0776)	Recitation Section (large)	1	1	
Principles of Geomatics (L0470)	Lecture	2	2	
Principles of Geomatics (L0471)	Recitation Section (small)	2	2	
Numeric and Matlab (L0125)	Practical Course	2	2	
Practical Course in Drinking Water Chemistry (L1744)	Practical Course	1	2	
Projects II (L1228)	Project Seminar	2	2	
Fire Protection and Prevention (L0472)	Lecture	2	2	

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



ourse L0211: Applied N	
	Seminar
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	4 schriftliche Ausarbeitungen und erfolgreiche Bearbeitung von semesterbegleitenden Vips
Lecturer	Dr. Gernod Deckelmann
Language	DE
Cycle	WiSe
Content	<ul> <li>Possible methods to solve engineering problems</li> <li>Application of numerical methods</li> <li>Basic steps in the finite element method</li> <li>Requests for the geometric modell</li> <li>Linear, quadratic and cubic elements</li> <li>Minimum total potential energy formulation and verification of results</li> <li>Non-linear problems and error-estimation procedures</li> <li>Application of ANSYS to solve typical problems in the fields of civil engineering</li> </ul>
Literature	Müller, Günter (Groth, Clemens) FEM für Praktiker ISBN: 3816926851 (Kt.) ISBN: 978-3-8169-2685-6 Renningen : expert-Verl, 2007 Groth, Clemens (Müller, Günter) FEM für Praktiker ISBN: 3816918581 Renningen : Expert-Verl, 2001 Chandrupatla, Tirupathi R (Belegundu, Ashok D.; Ramesh, T.) Introduction to finite elements in engineering ISBN: 0132162741 (United States ed.) ISBN: 9780132162746 (United States ed.) ISBN: 027376368 (International ed.) ISBN: 9780273763680 (International ed.) Upper Saddle River, NJ [u.a.] Prentice Hall, 2012 Gvk Moaveni, Saeed Finite element analysis : theory and application with ANSYS ISBN: 0132416514 ISBN: 9780132416511 Upper Saddle River, NJ Pearson Prentice-Hall, 2008 Gvk Patankar, Suhas V Numerical heat transfer and fluid flow ISBN: 0891165223 New York [u.a.] : Hemisphere Publ. Co, 1980 Bathe, Klaus-Jürgen (Zimmermann, Peter) Finite-Elemente-Methoden ISBN: 97803 (Gb.) ISBN: 978-3-540-66806-0 Berlin [u.a.] : Springer, 2002



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



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

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



Course L0370: Computa	tional Analysis of Structures		
Тур	Typ 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>		
Literature	<ul> <li>Skript zu Vorlesung</li> <li>Tutorials von SOFiSTiK</li> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>		



ourse L0286: Introduct	ction in Statitics with R		
Тур	Lecture		
Hrs/wk	1		
СР			
	Independent Study Time 16, Study Time in Lecture 14		
Examination Form	J		
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, tes distributions (t-F-X <sup>2</sup> -distribiution))		
	Correlation and Regression analysis (Confidence interval of calibration curves, linearity)		
	Statistic test procedures (mean value-t-Test, Chi^2-Test, F-Test)		
	Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test)		
	Introduction time series (tseries)		
	Introduction cluster analysis (k-means)		
	Regionales Rechenzentrum für Niedersachsen Statistik mit R Grundlagen der Datenanalyse , 2013		
	Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf		
	und die dazugehörige Aufgabensammlung http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf		
Literature	Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge von Toutenburg, Helge 2008 http://dx.doi.org/10.1007/978-3-540-77510-2http://dx.doi.org/10.1007/978-3-540-77510-2		
	R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran. project.org/doc/contrib/Short-refcard.pdf Grafiken und Statistik in R von Andreas Plank		
	Nachschlage         Skript         mit         Beispielen:         http://www.geo.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		
Typ Lecture		
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and scale	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur	
Lecturer	Prof. Peter Andree	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Overview of geomatics in general</li> <li>Units of measurements</li> <li>Generating of topographical maps</li> <li>Basic surveying instruments and handling</li> <li>Geodetic surveying lines and verification of measurements</li> <li>Methods of horizontal survey</li> <li>Components of geodetic surveying instruments</li> <li>Height determination</li> <li>Setting out points</li> <li>Topographical survey</li> <li>Directions and angles</li> <li>Determination of coordinates</li> <li>Traversing</li> <li>Basics on surveying and positioning with GNSS</li> </ul>	
Literature	Andree, P.:       Grundlagen der Geomatik (Skript)         Resnik, B. / Bill, R.:       Vermessungskunde für den Planungs- Bau- und Umweltbereich,         Wichmann-verlag       Vermessungskunde und Grundlagen der Statistik für das Bauwesen,         Witte, B. / Sparla, P.:       Vermessungskunde und Grundlagen der Statistik für das Bauwesen,         Wichmann-Verlag       Gruber, F.J. / Joeckel, R.:         Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag	



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

Course L0125: Numeric and Matlab		
Тур	Practical Course	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Fachtheoretisch-fachpraktische Arbeit	
Examination duration and scale	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): <ol> <li>Moler, C., Numerical Computing with MATLAB, SIAM, 2004</li> <li>The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007</li> <li>Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de</li> <li>Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005</li> </ol>	



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

ourse L1228: Projects II		
Тур	Project Seminar	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	Referat	
Examination duration and scale	ica zennminutide Prasentation	
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			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
	Mündliche Prüfung		
Examination duration and scale	20 min		
Lecturer	Andreas Kattge		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction</li> <li>fire in residential and office buildings</li> <li>town planning: location of residential, office and industry areas, location of fire stations</li> <li>design of roads an water pipes</li> <li>explosions</li> </ul>		
Literature	• Schneider U. : Ingenieurmethoden im baulichen Brandschutz. Expert Verlag, 2. Aufl., 2002		

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Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management Project Entrepreneurship (L0		<b>Typ</b> Lecture Project-/problem-based	Hrs/wk 3 2	<b>CP</b> 3 3
· · · · · · · · · · · · · · · · · · ·		Learning	_	-
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busir			
Educational Objectives	After taking part successfully, students have	reached the following learning	g results	
Professional Competence	After taking this module, students know the	important basics of many diff	oront aroas i	n Businoss and
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investmen and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations unde multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the leareport on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their feareport</li> </ul>	ecture to an entrepreneurship	project and v	vrite a coheren
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time ir	Lecture 70		
Credit points	6			
Examination	Subject theoretical and practical work			



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



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



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

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



Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 2, Study Time in Lecture 28
	Dr. Gernod Deckelmann
Language	
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	<ul> <li>Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006</li> <li>Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wänd Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007</li> <li>Neufert, Ernst (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als M und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernend</li> </ul>



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



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



Courses				
Title		Тур	Hrs/wk	СР
Wastewater Disposal (L027)	6)	Lecture	2	2
Wastewater Disposal (L027		Recitation Section (large)	1	1
Drinking Water Supply (L030	06)	Lecture	2	1
Drinking Water Supply (L030	08)	Recitation Section (large)	1	2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Basic knowledge on Chemistry and Biology</li> <li>Hydraulics of pipe systems and open channels</li> <li>Basic knowledge on water management: water quantity and water quality</li> <li>Basic knowledge on Environmental Legislation: Federal Water Act</li> </ul>			
Educational Objectives	After taking part successfully, students have reac	hed 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 can also assess existing problems in the field of sanitary engineering by considering legal, risk and saftey aspects. Furthermore, they know how to draft the features and effectiveness of important technologies of the future such as high- and low-pressure membrane filtration systems and techniques for the removal of trace pollutants.			
Skills	The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of the own to improve the existing water related infrastructures, systems and concepts.			
Personal Competence Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are able to form concepts on their own to optimize urban water infrastructure processes. Therefore they can acquire appropriate knowledge when being given some clues or information with regard to the approach to problems (preparation and follow-up of the exercises).			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points	6			
-	Written exam			
Examination duration and scale				
	General Engineering Science (German pr Engeneering: Compulsory General Engineering Science (German progr	rogram): Specialisation am, 7 semester): Specia		



 Assignment for the Following Curricula
 Elective Compulsory

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

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

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

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



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

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



Module M0869: Hy	draulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Recitation Section (large)	1	1
Hydraulic Engineering (L095		Lecture	2	2
Hydraulic Engineering (L096		Recitation Section (large)	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Hydraulik Engineering I			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering. The students are able to apply hydraulic engineering methods and approaches to basic practical			
Skills	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.			
Personal Competence				
Social Competence	The students are able to deploy their gaine able to work in team with engineers of othe		ms. Additior	naly, they will be
Autonomy	The students will be able to independently	extend their knowledge and app	ly it to new	problems.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
	The duration of the examination is 2 hours understanding of the lecture contents and o		s with respe	ct to the general
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective 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: Elective Compulsory			



Course L0957: Hydraulio	cs
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	<ul> <li>Flow of incompressible fluids in pipes and open channels</li> <li>Hydraulics of pipes</li> <li>Punps in hydraulic systems</li> <li>Open channel flow</li> <li>Regulative construction in open channel flow <ul> <li>Weirs</li> <li>Sliding panels</li> <li>Cross-section reduction by constructions</li> </ul> </li> </ul>
Literature	Zanke, Ulrich C. , Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003 Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992

Course L0958: Hydrauli	urse L0958: Hydraulics	
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Course L0959: Hydraulio	c Engineering
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	SoSe
Content	<ul> <li>Fundamentals of hydraulic engineering</li> <li>Introduction and hydrological cycle</li> <li>River engineering <ul> <li>Regime theory of natural rivers</li> <li>Sediment transport</li> <li>Regulation of rivers</li> <li>Bank protection / protection of river bed</li> <li>Tidal rivers</li> </ul> </li> <li>Flood protection <ul> <li>Dikes</li> <li>Flood contraol basins</li> </ul> </li> <li>Hydraulic power</li> <li>Inland waterways engineering <ul> <li>waterways</li> <li>Locks and ship lifts</li> <li>Fish passages</li> </ul> </li> <li>Nature-oriented hydraulic engineering</li> </ul>
Literature	Strobl, T. & Zunic, F: Wasserbau, Springer 2006 Patt, H. & Gonsowski, P: Wasserbau, Springer 2011

Irse 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				
Title	ngineering/Bioprocess Engineering (L0829)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b>
Fundamentals of material e		Lecture	2	2
Module Responsible	Prof. Michael Schlüter			
Admissior Requirements	None			
Recommended Previous Knowledge	Inono			
Educational Objectives	After taking part successfully, students have	e reached the following le	earning results	
Professiona Competence				
<ul> <li>give an overview of the most important fields on process and bioprocess engineering,</li> <li>explain some working methods for different fields in process engineering.</li> </ul>		eering,		
Skills	<ul> <li>After passing this module the students shote</li> <li>list and outline the most important fine</li> <li>name the most important working engineering,</li> <li>read and prepare an engineering description of explain the most important technologies</li> <li>scheme typical chemical and bid pointers.</li> </ul>	elds of process engineer approaches or method rawing, ogies for wastewater and	s of the different fie exhaust air treatme	nt
Personal Competence	The students are able to			
Social Competence	<ul> <li>work out results in groups and docu</li> <li>provide appropriate feedback and h</li> </ul>		own performance c	onstructively.



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

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

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



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



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

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

### TUHH

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



Module M0937: Ph	ysical Chemistry					
Courses						
<b>Title</b> Physical Chemistry (L0833) Physical Chemistry (L0835)		<b>Typ</b> Lecture Practical Course	<b>Hrs/wk</b> 2 2	<b>CP</b> 2 1		
Module Responsible	Prof. Hans-Ulrich Moritz					
Admission Requirements						
Recommended Previous Knowledge	I Contents of the previous modules increance chemistry, physics for engineers and mathematics LIII					
	After taking part successfully, students have reached the following learning results					
Professional Competence						
Knowledge	The students are able, -to repeat the basic concepts of physical chemistry					
	-to describe and summarize the underlying concepts of mass-, heat- and momentum transfer.					
	- to interpret phase diagrams and affiliate kinetic rate laws.					
Skills	The students are able to - conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.					
	- assess new applications with respect to environmental sustainability.					
	- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kineti calculations.					
Personal Competence						
Social Competence	The students are able to plan, prepare, conduct and document experiments according to scientific guidelines in small groups.					
	The students are able to reflect their subject-specific knowledge orally in a team and to discuss it with 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 Lecture 56					
Credit points	3					
Examination	Written exam					
Examination duration and scale	180 min					
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: 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): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Process 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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of chemical reactions, introduction into transport phenomena, phase equilibria, equilibria at surfaces and interfaces
	<ul> <li>P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013</li> <li>P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008</li> <li>G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012</li> <li>R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993</li> <li>U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011</li> </ul>



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

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Courses				
Title Fundamentals of Fluid Mechanics (L0091) Fluid Mechanics for Process Engineering (L0092)		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	· · · · · · · · · · · · · · · · · · ·			
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to:</li> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in process engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physic boundary conditions</li> </ul>			
Skills	<ul> <li>The students are able to</li> <li>describe and model incompressible flows mathematically</li> <li>reduce the governing equations of fluid mechanics by simplifications to archive quantitativ solutions e.g. by integration</li> <li>notice the dependency between theory and technical applications</li> <li>use the learned basics for fluid dynamical applications in fields of process engineering</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>The students</li> <li>are capable to gather information frinformation to the context of the lect</li> <li>able to work together on subject results effectively in English (e.g. drives)</li> <li>are able to work out solutions for expresent the results.</li> </ul>	ture and elated tasks in small groups. Th uring small group exercises)	ey are able	to present the
Autonomy	<ul> <li>The students are able to</li> <li>search further literature for each topic and to expand their knowledge with this literature,</li> <li>work on their exercises by their own and to evaluate their actual knowledge with the feedback.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engineering: Compulsory General Engineering Science (German p	ogram): Specialisation Bioproces n program): Specialisation I	ss Engineeri Energy and	ng: Compulso I Enviromenta



Assignment for the Following Curricula	I Energy and Environmental Engineering. Core qualification: Compulsory
	Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core gualification: Compulsory

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



Тур	Recitation Section (large)		
Hrs/wk	2		
CP	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle	SoSe		
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented or the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chall board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.		
Literature	<ol> <li>Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009.</li> <li>Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden Springer-Verlag, Berlin, Heidelberg, 2006.</li> <li>Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley &amp; Sons, 1994</li> <li>Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006</li> <li>Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008</li> <li>Kuhlmann, H.C.: Strömungsmechanik. 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 M0757: Bio	ochemistry and Microbiology	,			
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Courses		_			
<b>Title</b> Biochemistry (L0351)		<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>CP</b> 2	
Biochemistry (L0728)		Project-/problem-based Learning	1	1	
Microbiology (L0881)		Lecture	2	2	
Microbiology (L0888)		Project-/problem-based Learning	1	1	
Module Responsible	Dr. Paul Bubenheim				
Admission Requirements	None				
Recommended Previous Knowledge	none				
Educational Objectives	After taking part successfully, students I	have reached the following learning	g results		
Professional Competence					
	<ul> <li>explain the methods of biological and biochemical research to determine the prop biomolecules</li> </ul>				
	- name the basic components of a living organism				
Knowledge	- explain the principles of metabolism				
	- describe the structure of living cells				
	-				
Skills					
Personal Competence					
	The students are able,				
	- to gather knowledge in groups of about 10 students				
Social Competence	to introduce their own knowledge and to argue their view in discussions in teams				
	- to divide a complex task into subtasks	, solve these and to present the cor	nbined result	s	
Autonomy	The students are able to present the res	sults of their subtasks in a written re	port		
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84			
Credit points	6				
Examination	Written exam				
Examination duration and scale	90 min				
-	General Engineering Science (German General Engineering Science (German Compulsory Bioprocess Engineering: Core qualifica General Engineering Science (English General Engineering Science (English Compulsory Technomathematics: Specialisation III.	n program, 7 semester): Specialisat ation: Compulsory program): Specialisation Bioproces program, 7 semester): Specialisat	ion Bioproce ss Engineerir ion Bioproce	ss Engineering: ng: Compulsory	



Course L0351: Biochem	istry
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	<ol> <li>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> </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
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	<ol> <li>The molecular logic of Life</li> <li>Biomolecules:         <ol> <li>Amino acids, peptides, proteins</li> <li>Carbohydrates</li> <li>Lipids</li> </ol> </li> <li>Protein functions, Enzymes:         <ol> <li>Michaelis-Menten kinetics</li> <li>Enzyme regulation</li> <li>Enzyme nomenclature</li> </ol> </li> <li>Cofactors and cosubstrates, vitamines</li> <li>Metabolism:         <ol> <li>Basic principles</li> <li>Photosynthesis</li> <li>Glycolysis</li> <li>Citric acid cycle</li> <li>Respiration</li> <li>Anaerobic respirations</li> <li>Fatty acid metabolism</li> <li>Amino acid metabolism</li> </ol> </li> </ol>
Literature	Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn, Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin



Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	<ol> <li>The procaryotic cell         <ul> <li>evolution</li> <li>taxonomy and specific properties of Archaea, Bacteria, and viruses</li> <li>structure and properties of the cell</li> <li>growth</li> </ul> </li> <li>Metabolism         <ul> <li>fermentation and anaerobic respiration</li> <li>methanogenesis and the anaerobic food chain</li> <li>degradation of polymers</li> <li>chemolithotrophy</li> </ul> </li> <li>Microorganisms in relation to the environment         <ul> <li>chemotaxis and motility</li> <li>Elemental cycle of carbon, nitrogen and sulfur</li> <li>biofilms</li> <li>symbiotic relationships</li> <li>extremophiles</li> <li>biotechnology</li> </ul> </li> </ol>
Literature	<ul> <li>Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)</li> <li>Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehema "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 €)</li> </ul>



Tvp	Project-/problem-based Learning
Hrs/wk	
CP	
	Independent Study Time 16, Study Time in Lecture 14
	Dr. Christian Schäfers
Language	DE
Cycle	
Content	<ol> <li>The procaryotic cell         <ul> <li>evolution</li> <li>taxonomy and specific properties of Archaea, Bacteria, and viruses</li> <li>structure and properties of the cell</li> <li>growth</li> </ul> </li> <li>Metabolism         <ul> <li>fermentation and anaerobic respiration</li> <li>methanogenesis and the anaerobic food chain</li> <li>degradation of polymers</li> <li>chemolithotrophy</li> </ul> </li> <li>Microorganisms in relation to the environment         <ul> <li>chemotaxis and motility</li> <li>Elemental cycle of carbon, nitrogen and sulfur</li> <li>biofilms</li> <li>symbiotic relationships</li> <li>extremophiles</li> <li>biotechnology</li> </ul> </li> </ol>
Literature	<ul> <li>Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)</li> <li>Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehema "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 €)</li> </ul>



Courses				
<b>Title</b> Phase Equilibria Thermodynamics (L0114) Phase Equilibria Thermodynamics (L0140) Phase Equilibria Thermodynamics (L0142)		<b>Typ</b> Lecture Recitation Section (smal Recitation Section (large		<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	NANA			
Recommended Previous Knowledge		dynamics I and II		
Educational Objectives	After taking part successfully, students have	ve reached the following learnir	ng results	
Professional Competence				
Knowledge	<ul> <li>Starting from the very basics of thermodynamics, the students learn the mathematical tools describe thermodynamic equilibria.</li> <li>They learn how state variables are influenced by the mixing of compounds and learn concep to quantitatively describe these properties.</li> <li>Moreover, the students learn how phase equilibria can be described mathematically and whic phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibriur Furthermore the fundamentals of reaction equilibria are taught.</li> <li>For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught.</li> </ul>			
Skills	<ul> <li>Applying their knowledge, the s determination of the equilibrium state. The students know models which a equilibrium state and they are able. For specific applications, they a properties of compounds as well a</li> <li>Beside pure compound propertie mixtures.</li> <li>The students know how to visual interpret the occurring phenomena</li> <li>Based on their knowledge, the stut the basis for many separation and</li> </ul>	ate and know how to simplify th can be used to determine the p to solve the resulting mathema re able to self-reliantly find s model parameters in literature s the students are capable of alize phase equilibria graphic to dents are able to understand for	ese equations properties of the trical relations necessary p e sources. describing the cally and the undamental c	s meaningfully he system in t s. hysico-chemic he properties y know how oncepts that a
Personal Competence Social Competence	The students are able to work in small a		ling problems	s and to prese
Autonomy	<ul> <li>The students are able to find necessary information self-reliantly in literature sources and figudge their quality.</li> <li>During the semester the students are able to check their learning progress continuously i exercises. Based on this knowledge the students can adept their learning process.</li> </ul>			
Workload in Hours				



Credit.points Examination	∯ritten exam	
Examination duration and scale	20 minutes; theoretical questions and calculations	
•	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Process Engineering: Core qualification: Compulsory	

Course L0114: Phase Ec	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: eaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid- Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>



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



Course L0142: Phase Ec	quilibria Thermodynamics
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	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>

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Courses				
Title	n,	Тур	Hrs/wk	CP
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (larg	3 e) 1	4 2
		ricolation coolion (larg	o) !	-
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
Recommended	The modul is an introduction to the	ne theory of signals and systems.	Good knowled	ge in maths a
	covered by the moduls Mathematik	1-3 is expected. Further experience	e with spectral	
	(Fourier series, Fourier transform, L	aplace transform) is useful but not re	quired.	
Educational Objectives	After taking part successfully, stude	nts have reached the following learn	ing results	
Professional				
Competence				
		and describe signals and linear time eory. They are able to apply the fu		
Knowledge		signals and systems. They can desc		
Knowledge		y in both time and image domain. In		
	effects in time domain and image signal to a discrete-time signal.	domain which are caused by the t	ransition of a c	continuous-tir
		and analyse deterministic signals an	d linear time-in	variant svster
	using methods of signal and syste	m theory. They can analyse and de	esign basic sys	stems regardi
OKIIIS		itude and phase response, stability,		hey can asse
Personal Competence	the impact of L H systems on the sig	nal properties in time and frequency	domain.	
-	The students can jointly solve speci	fic problems		
		relevant information from appropriat	e literature sou	urces. They c
Autonomy		ring the lecture period by solving tu		
	clicker system.			
	Independent Study Time 124, Study	/ Time in Lecture 56		
Credit points				
Examination				
Examination duration and scale	90 min			
	General Engineering Science (Gerr	man program): Specialisation Electric	cal Engineering	g: Compulsory
		man program): Specialisation Compu		
	<b>u</b>	nan program): Specialisation Proces nan program): Specialisation Biopro	• •	• •
		(German program): Specialisatio		
	Engeneering: Compulsory			
	General Engineering Science Compulsory	(German program): Specialisatio	n Mechanica	I Engineerir
		nan program): Specialisation Biome	dical Engineeri	ng: Compulso
		rman program, 7 semester): Specia	isation Electric	al Engineerir
	Compulsory General Engineering Science (Ge	erman program, 7 semester): Spec	cialisation Con	nputer Scienc
	Compulsory			
		rman program, 7 semester): Specia	alisation Proces	ss Engineerin
	Compulsory General Engineering Science (Gen	man program, 7 semester): Specialis	ation Bioproce	ss Engineerin
	Compulsory			
		man program, 7 semester): Specialis	ation Biomedic	al Engineerin
	Compulsory General Engineering Science (Gerr	man program 7 competer); Specialis	ation Machania	al Enginoprir
		Ilali Dibulatti. 7 semesien Sherans	allon Mechanic	al chomeen.



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



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



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



Courses				
<b>Title</b> Bioprocess Engineering - Fu	indamentals (1 0841)	<b>Typ</b> Lecture	Hrs/wk	<b>СР</b> 3
Bioprocess Engineering Fu		Recitation Section (large)		1
	indamental Practical Course (L0843)	Practical Course	2	2
Module Responsible	Prof. Andreas Liese			
Admission Requirements	None			
Recommended Previous Knowledge	none, module "organic chemistry", module	"fundamentals for process eng	ineering"	
Educational Objectives	After taking part successfully, students have	e reached the following learnin	g results	
Professional				
Competence				
Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to classi different types of kinetics for enzymes and microorganisms, as well as to differentiate different types inhibition. The parameters of stoichiometry and rheology can be named and mass transport processe in bioreactors can be explained. The students are capable to explain fundamental bioproces management, sterilization technology and downstream processing in detail.			
Skills Personal Competence Social Competence Autonomy	<ul> <li>After successful completion of this module,</li> <li>describe different kinetic approach corresponding parameters</li> <li>predict qualitatively the influence or growth inhibition on the fermentatio</li> <li>analyze bioprocesses on basis of s</li> <li>distinguish between scale-up criter aerobic as well as microaerobic) biotechnical problem</li> <li>propose solutions to complicated bimodels</li> <li>to explore new knowledge resource</li> <li>identify scientific problems with continue to document and discuss their procession</li> </ul>	hes for growth and substrate- f energy generation, regeneration n process toichiometry and to set up / solveria for different bioreactors and to compare them as well a iotechnological problems and es and to apply the newly gained crete industrial use and to form edures as well as results in a so this should be able to debate ition to their own opinions an drivenments.	ion of redox ve metabolic nd bioproces us to apply to to deduce the ed contents ulate solution cientific mann technical que d increase th echnical prol	equivalents ar flux equations ses (anaerob hem to curre e correspondir ns. ner sestions in sma heir capacity f
Workload in Hours	Independent Study Time 96, Study Time in	Locturo 84		
Credit points				
Examination				
Examination duration				
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory	ogram): Specialisation Bioproce rogram, 7 semester): Speciali	ess Engineeri sation Proce	ng: Compulso ss Engineerin



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

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



	Recitation Section (large)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	<ol> <li>Introduction (Prof. Liese, Prof. Zeng)</li> <li>Enzymatic kinetics (Prof. Liese)</li> <li>Stoichiometry I + II (Prof. Liese)</li> <li>Microbial Kinetics I+II (Prof. Zeng)</li> <li>Rheology (Prof. Liese)</li> <li>Mass transfer in bioprocess (Prof. Zeng)</li> <li>Continuous culture (Chemostat) (Prof. Zeng)</li> <li>Sterilisation (Prof. Zeng)</li> <li>Downstream processing (Prof. Liese)</li> <li>Repetition (Reserve) (Prof. Liese, Prof. Zeng)</li> </ol>
Literature	siehe Vorlesung

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



Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (LC		Lecture	2	2
Heat and Mass Transfer (LC Heat and Mass Transfer (L1	,	Recitation Section (small) Recitation Section (large)	1 1	2 2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge: Technical Thermodyna	amics		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>procedural apparatus (e. g. heat e</li> <li>They are capable of distinguish namely heat conduction, heat tran</li> <li>The students have the ability to describe mass transfer qualitative</li> <li>They are able to depict the analo linked processes in detail.</li> </ul>	and characterize different kinds onsfer and thermal radiation. explain the physical basis for material and quantitative by using suitable	ss transfer mass trans	in detail and fer theories.
Skills	<ul> <li>using the gained knowledge a respectively.</li> <li>They are capable to solve spectemperature alteration in fluids) a</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish betwork they can use this knowledge for column, rectification column).</li> <li>In this context, the students are compass exchanger for a specific a respectively.</li> <li>In addition, they can calculate box apparatus.</li> <li>The students are capable to context are capable to context.</li> </ul>	nd to calculate the corresponding I the students can execute scaling u ween diffusion, convective mass tr or the description and design of capable to choose and design func- application considering their advan- th, steady-state and non-steady-state nect their knowledge obtained in the courses thermodynamics, fluid	g energy a heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate processe his course	and mass flow emical reactor cal processes d mass transfe (e.g. extraction pes of heat ar disadvantage es in procedur with knowlego
Personal Competence	<ul> <li>The students are capable to wor results orally in a reasonable mar</li> </ul>	k on subject-specific challenges i nner to tutors and other students.	n teams an	d to present th
	<ul> <li>The students are able to find and</li> <li>They are able to prove their I procedure continuously (clicker-</li> </ul>	-	ourse with	accompanyir



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



Course L0101: Heat and	Mass Transfer
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	<ol> <li>Heat transfer         <ul> <li>Introduction, one-dimensional heat conduction</li> <li>Convective heat transfer</li> <li>Multidimensional heat conduction</li> <li>Non-steady heat conduction</li> <li>Thermal radiation</li> </ul> </li> <li>Mass transfer         <ul> <li>one-way diffusion, equimolar countercurrent diffusion</li> <li>boundary layer theory, non-steady mass transfer</li> <li>Heat and mass transfer single particle/ fixed bed</li> <li>Mass transfer and chemical reactions</li> </ul> </li> </ol>
Literature	<ol> <li>H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer</li> <li>VDI-Wärmeatlas</li> </ol>

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

Course L1868: Heat and Mass Transfer	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course



Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Process		Lecture	2	2
Thermal Separation Process		Recitation Section (small)	2	2
Thermal Separation Process		Recitation Section (large) 1		1
Separation Processes (L115	59)	Practical Course	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodyna	mics III		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence		<u>_</u>		
Knowledge	<ul> <li>The students develop an understar process, the estimation of the energ and the selection of separation syste</li> <li>They have good knowledge of desig</li> </ul>	y demand of a process, the po ems	ssibilities of	energy savin
Skills	<ul> <li>Using the gained knowledge the sturseparation process and can close th</li> <li>The students can use different graph and define the amount of theoretical</li> <li>They can select and design a basic on the advantages and disadvantag</li> <li>The students are capable to obtar appropriate sources (diagrams and the students are able to prove their)</li> <li>The students are able to prove their)</li> <li>The students are able to discust experimental work with the teachers</li> </ul>	e associated energy and materi ohical methods for the designir stages required type of thermal separation proc es of the process ain independently the needed tables) discontinuous processes theoretical knowledge in the exp s the theoretical background in colloquium.	al balances ng of a sep ess for a gir d material cerimental l and the nt of other la	aration proce ven case base properties fro ab work. content of th ectures and us
Personal Competence	<ul> <li>The students can work technical a</li> </ul>	assignments in small groups a	and presen	t the combine
Social Competence	<ul> <li>results in the tutorial</li> <li>The students are able to carry out p division of labor between them. The scientifically in a report.</li> </ul>		-	
Autonomy	<ul> <li>The students are capable to obt themselves and assess their quality</li> <li>The students can proof the state of t this way control their learning process</li> </ul>	heir knowledge with exam rese		



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



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



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



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



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



Module M0892: Ch	emical Reaction Engineering			
Courses				
Title         Chemical Reaction Engineering (Fundamentals) (L0204)         Chemical Reaction Engineering (Fundamentals) (L0244)         Experimental Course Chemical Engineering (Fundamentals) (L0221)		<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	None			
	Contents of the previous modules mathematics as well as computational methods for engineers		chnical therr	nodynamics I+I
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties.			
	<ul> <li>After successful completion of the module, students are able to:</li> <li>apply different computational methods to dimension isothermal and non-isothermal ideal reactor</li> <li>Skills</li> <li>determine and compute stable operation points for these reactors ,</li> <li>conduct experiments on a lab-scale pilot plants and document these according to scieguidelines.</li> </ul>			
Skillo				
Skiis				
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	Written exam			
Examination duration and scale	120 min			
-	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory			

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



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



1 1	C. Emia, E. Klamm, Tachnische Chemie, Springer
	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
1	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
1	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
1	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
1	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		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup		
Language	DE		
Cycle	WiSe		
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)		
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)		
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)		
	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler- number, differential and integral method of kinetic analysis, laboratory reactors for kinetic		



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



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



Module M0945: Bi	oprocess Engineering - Adva	nced			
-					
Courses					
Title Bioprocess Engineering - Ad	dyanced (I 1107)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 4	
Bioprocess Engineering - Ad Bioprocess Engineering - Ad		Recitation Section (small)	2	2	
Module Responsible	Prof. An-Pina Zena				
Admission Requirements					
Recommended Previous Knowledge	I Contant at modula "Riochamical Engine	ering I"			
	After taking part successfully, students h	ave reached the following learning	results		
Professional Competence					
	After successful completion of this modu	le, students should be able to			
	describe and explain different kin	netic approaches for growth and su	bstrate-upta	ke	
Knowledge	<ul> <li>identification of scientific problems with concrete industrial use (cultivation of microorganism and mammalian cells)</li> </ul>				
	<ul> <li>describe and explain important downstreaming steps for proteins and their application as well as basic immobilization methods</li> </ul>				
	After successful completion of this module, students should be able to				
	- to identifiy scientific questions or possible practical problems for concrete industrial applications (e 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 productio processes appropriate solutions ,				
Skills	s - To describe the effects of the energy generation, the regeneration of reduction equivalents , and th 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 teams to enhance the ability to take position to their own opinions and increase their capac teamwork.				
Autonomy	After completion of this module particip their knowledge to previously unknown		es of knowl	edge and app	
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56			
Credit points	I				
Examination	Written exam				



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

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



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



Courses				
Title Practical Exercise Environm		<b>Typ</b> Practical Course	Hrs/wk 1	<b>CP</b> 1
Environmental Technologie	(L0326)	Lecture	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic chemistry an	d biology		
Educational Objectives	After taking part successfully, students have read	ched the following learn	ning results	
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound knowledge of environment technology. They are able to describe the behaviour of chemicals in the environment. Students car give an overview of scientific disciplines involved. They can explain terms and allocate them to relate methods.			
Skills	Students are able to propose appropriate management and mitigation measures for 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 defent 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 an multidisciplinary. They are able to develop different approaches to the task as a group as well as t discuss their theoretical or practical implementation.			
Autonomy	Students can independently exploit sources about of the subject, acquire the particular knowledge an tranfer it to new problems.			
Workload in Hours	Independent Study Time 48, Study Time in Lectu	ire 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 nour			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Elect Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy a 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): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory			

## Process Engineering: Core qualification: Elective Compulsory

TUHH

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

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

Γ



Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
-			_	_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, students	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 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 ar frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence		to jointly solve technical problems, a	and experim	entally validat
Autonomy	their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Houre	Independent Study Time 124, Study 1	lime in Lecture 56		
Credit points				
-	Written exam			
Examination duration and scale				
		an program): Core qualification: Comp man program, 7 semester): Special	isation Con	

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



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

	Lecture
Hrs/wk	
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 Not locus plots Not locus plots Not locus plots Not locus stability criterion, phase and gain margin Not plot systems  Root locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus and frequency response of time delay systems Not locus to that ab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Courses				
Title         Process and Plant Engineering I (L0095)         Process and Plant Engineering I (L0096)         Process and Plant Engineering I (L1214)		<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible			•	-
Admission	None			
Recommended	unit operation of thermal an dmechanic chemical reactor eingineering	al separation processes		
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence	students can:			
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 - estimation of component streams of ch - solution of data reconcilliation tasks - conduction of process synthesis - economic evaluation of processes and	nemical plants using linear compone		
Personal Competence				
Social Competence				
Autonomy				
Workload In Hours Credit points	Independent Study Time 124, Study Tin	ne in Lecture 56		
-	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following Curricula	General Engineering Science (German General Engineering Science (German General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (Ger Enviromental Engineering: Elective Cor Bioprocess Engineering: Core qualifica General Engineering Science (English General Engineering Science (English General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English Compulsory	program): Specialisation Bioproces n program, 7 semester): Specialisation program, 7 semester): Specialisation man program, 7 semester): Sp npulsory tion: Compulsory program): Specialisation Bioprocess program): Specialisation Process En n program, 7 semester): Specialisation	as Engineeri ation Proces on Bioproce decialisation s Engineering: ngineering: ation Proces	ng: Compulso ss Engineerir ss Engineerir n Energy a ng: Compulso Compulsory ss Engineerir



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

Irse L0095: Process	and Plant Engineering I	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Course work	none	
	Prof. Georg Fieg	
Language Cycle		
Content	<ol> <li>Introduction         Structure and operation of production plants         Operational business process         Technical process design         Motivation and targets of process development         Life cycle of production plants         Engineering methods and tools         Mass and energy balances         Strategies of process synthesis         Graphical representation of processes         Multidimensional regression         </li> </ol>	
	<ul> <li>S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679</li> <li>H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74</li> <li>Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157</li> <li>E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997</li> <li>M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916</li> <li>R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&amp;Co.KGaA, Weinheim, 2004</li> <li>J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988</li> <li>G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19</li> <li>G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306</li> <li>G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213</li> <li>G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133</li> </ul>	



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

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

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

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Courses		
Title	Typ Hrs/wk CP	
Particle Technology I (L0434		
Particle Technology I (L043		
Particle Technology I (L044)		
	Prof. Stefan Heinrich	
Admission Requirements	INONE	
Recommended Previous Knowledge		
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	<ul> <li>name and explain processes and unit-operations of solids process engineering,</li> <li>characterize particles, particle distributions and to discuss their bulk properties</li> </ul>	
Skills	<ul> <li>Students are able to</li> <li>choose and design apparatuses and processes for solids processing according to the desired solids properties of the product</li> <li>asses solids with respect to their behavior in solids processing steps</li> <li>document their work scientifically.</li> </ul>	
Personal Competence		
Social Competence	The students are able to discuss scientific topics orally with other students or scientific personal and t develop solutions for technical-scientific issues in a group.	
Autonomy	develop solutions for technical-scientific issues in a group.	
,	develop solutions for technical-scientific issues in a group.	
Workload in Hours Credit points	develop solutions for technical-scientific issues in a group. Students are able to analyze and solve questions regarding solid particles independently. Independent Study Time 110, Study Time in Lecture 70 6	
Workload in Hours Credit points Examination	develop solutions for technical-scientific issues in a group. Students are able to analyze and solve questions regarding solid particles independently. Independent Study Time 110, Study Time in Lecture 70 6 Written exam	
Workload in Hours Credit points	develop solutions for technical-scientific issues in a group.         Students are able to analyze and solve questions regarding solid particles independently.         Independent Study Time 110, Study Time in Lecture 70         6         Written exam         90 minutes	



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

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

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



Osumas I 0440, Dautiala 7	Fachurala ma I
Course L0440: Particle	lechnology I
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.



and Controlling. In particular they are able to         explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management         Knowledge         Knowledge         Knowledge         explain the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of entreprimeurial projects         explain the relevance of planning and decision making in Business, esp. in situations une multiple objectives and uncertainty, and explain some basic methods from mathematic Finance         explain the relevance of planning and decision making in Business, esp. in situations une multiple objectives and uncertainty, and explain some basic methods.         Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to         analyse Management goals and structures of companies         spaply methods for decision making under multiple objectives, under uncertainty and under rit analyse organisational and staff structures of companies         spaply methods for decision making under multiple objectives, under uncertainty and under rit analyse production and procurement systems and Business information systems         analyse production and procurement systems and Business information systems         analyse methods from accounting, costing and controlling to predefined problems         esplay their knowledge from the lectu	Module M0829: Fo	undations of Management			
Title         Typ         Hrs.wk         CP           Introduction to Management (LOB80)         Lecture         3         3           Module Responsible         Project Entrepreneurship (LOB80)         Project-Entrepreneurship (LOB80)         2         3           Module Responsible         Prot. Christoph Ihl         Admission         None         2         3           Requirements         Vinne         Basic Knowledge of Mathematics and Business         Educational Objectives         Alter taking part successfully, students have reached the following learning results           Professional Competence         Alter taking part successfully, students have reached the following learning results         Professional Competence         Alter taking this module, students know the important basics of many different areas in Business a management, incovation the most import aspects of entrepreneural projects         explain the most import aspects of entrepreneural projects         explain the most import aspects of entrepreneural projects         explain the relevance of planning and doctaion making in Business, esp. in situations un multiple objectives and usplain basic business functions as production, procurement and sourci supply, chain management, incovation management and marketing         explain the relevance of planning and doctaion making in Business, esp. in situations un management, incovation management and succers of and poals in Management.         Information under rit aspects of entrepreneurship project in a team. In particular, they are able to           Knowledge         ex	Courses				
Module Responsible         Prof. Christoph Inl           Admission Requirements Previous Knowledge         Basic Knowledge of Mathematics and Business           Educational Objectives         After taking part successfully, students have reached the following learning results           Professional Competence         After taking part successfully, students have reached the following learning results           Professional Competence         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investing and Controlling. In particular they are able to           Knowledge         • explain the differences between Economics and Management and the sub-disciplines Management and to name important aspects of and goals in Management and mare the most import and controlling. In particular they are able to explain the relevance of planning and decision making in Business, esp. in situations une multiple objectives and uncertainty, and explain some basic methods from mathematic Finance           • state basics from accounting and decision making in Business, esp. in situations une multiple objectives and uncertainty, and explain some basic methods.           Students are able to analyse business units with respect to different criteria (organization, objectiv e analyse organization and procurement systems and Business information systems analyse organizational and traff structures of companies e apply basic methods from accounting, costing and controlling to predefined problems           Personal Competence         Students are able to • work successfully in a team of students. • to communicate appropriat	Title Introduction to Management		Lecture Project-/problem-based	3	3
Admission Requirements Recommended Previous Knowledge         Basic Knowledge of Mathematics and Business           Educational Objectives Basic Knowledge         After taking part successfully, students have reached the following learning results           Professional Competence         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investim and Controlling. In particular they are able to           Knowledge         • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management and sepects of entroprenural projects           Knowledge         • explain the osplan basic business tunctions as production, procurement and source management, innovation management quanization and human ressource management, informali management innovation management quanization and human ressource management, informali management innovation management quantization and human ressource management, informali management and councertainty, and explain some basic methods from multiple objectives and uncertainty, and explain some basic methods.           Students are able to analyse business units with respect to different criteria (organization, objective state basics for decision making under multiple objectives, under uncertainty and under rit enalyse poduction and procurement systems and Business information systems enalyse poduction and procurement systems and Business information systems enal			Learning		
Requirements         Nonite           Bacommende Previous Knowledge         Basic Knowledge of Mathematics and Business           Educational Objectives         After taking part successfully, students have reached the following learning results           Professional Competence         After taking this module, students know the important basics of many different areas in Business a management, from Planning and Organisation to Marketing and Innovation, and also to Investme and Controlling. In particular they are able to           Knowledge         • explain the differences between Economics and Management and mame the most important definitions from the field of Management and acentrolling in particular they are able to           Knowledge         • explain the most important definitions from the field of Management angects of entrepmeurial projects           describe and explain basic business functions as production, procurement and sourch supply chain management, organization and human ressource management, informati management, innovation management and rekeing           explain the relevance of planning and decision making in Business, explain some basic methods from mathematic Finance           state basics from accounting and costing and selected controlling methods.           Students are able to analyse business units with respect to different criteria (organization, objectiv strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to           analyse management and procurement systems and Business information systems           analyse and apply basic methods from mathematica finance to predefined p					
Previous Knowledge         Basic Knowledge of Mainematics and Business           Educational Objectives         After taking part successfully, students have reached the following learning results           Professional Competence         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investme and Controlling. In particular they are able to           Knowledge         • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management aspects of entreprenuital projects           Knowledge         • explain the most important definitions from the field of Management, informati management, innovation management, and marketing           explain the relevance of planning and decision making in Business, esp. in situations une multiple objectives and uncertainty, and explain some basic methods.           Students are able to analyse business units with respect to different criteria (organization, objective state basics from accounting and costing and selected controlling methods.           Students are able to analyse business units with respect to different criteria (organization, objective state basics for accounting and costing and Business information systems analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing aselect and apply basic methods of marketing aselect and apply basic methods from marketing aselect and apply basic methods from marketing asalyse and apply basic methods from marketing asalyse are able to bo work successtully in a team of students bo cooperate respectfull	Requirements				
Protessional Competence         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investme and Controlling. In particular they are able to                • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management and Controlling. In particular they are able to                 Knowledge          • explain the most important aspects of and goals in Management and mame the most import aspects of entrepriverular projects                 Knowledge          • explain the rost important aspects of and explain basic business functions as production, procurement and sourcit supply chain management, organization and human ressource management, informati management, innovation management and marketing                 explain the relevance of planning and decision making in Business, esp. in situations und multiple objectives and uncertainty, and explain some basic methods from mathematic Finance                 state basics from accounting and costing and selected controlling methods.            Students are able to analyse business units with respect to different criteria (organization, objective analyse apply methods for decision making under nulliple objectives, under uncertainty and under ri- analyse and papib basic methods from matchendering                 saple methods for decision making under nulliple objectives, under uncertainty and apply basic methods from matchenge                 sanalyse anaplob saic m	Previous Knowledge	Basic Knowledge of Mathematics and Bus			
Competence       After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investme and Controlling. In particular they are able to         Knowledge       • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management :         Knowledge       • explain the differences between Economics and Management and mane the most important aspects of and goals in Management and mane the most important aspects of and goals in Management and mane the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of and goals in Management and name the most important aspects of and goals in Management and marketing         explain the relevance of planning and decision making in Business, esp. in situations und miliple objectives and uncertainty, and explain some basic methods for mathematic finance         state basics from accounting and costing and selected controlling methods.         Students are able to analyse business units with respect to different uncertainty and under ric analyse organisational and staff structures of companies         analyse organisational and staff structures of companies         analyse organisational and staff structures of the appropriately         analyse organistemetods from market			re reached the following learning	ng results	
After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to investing and Controlling. In particular they are able to            Knowledge           explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management             Knowledge           explain the most important aspects of and goals in Management and mame the most important aspects of entreprneurial projects             Knowledge           explain the most important aspects of and goals in Management and mame the most important aspects of entreprneurial projects             Knowledge           explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from mathematic Finance             explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods.             Skills               Skills               Skills               Skills               Skills               Skills					
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 rise         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         apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project         Students are able to         scial Competence         Social Competence         Autonomy         Autonomy         work in a team and to organize the team themselves         to write a report on their project.         Morkload in Hours         Independent Study Time 110, Study Time in Lecture 70         Credit points         6         Examination         Subject theoretical and practical work	Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance</li> </ul>			
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 cohere report on the project         • to communicate appropriately and         • to cooperate respectfully with their fellow students.         Students are able to         • work in a team and to organize the team themselves         • to write a report on their project.         Workload in Hours         Independent Study Time 110, Study Time in Lecture 70         Credit points         6         Examination         Subject theoretical and practical work	Skills	<ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> </ul>			
Social Competence       • 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         • work in a team and to organize the team themselves         • to write a report on their project.         Workload in Hours         Independent Study Time 110, Study Time in Lecture 70         Credit points         6         Examination         Subject theoretical and practical work	Personal Competence				
Autonomy       • work in a team and to organize the team themselves         • to write a report on their project.         Workload in Hours       Independent Study Time 110, Study Time in Lecture 70         Credit points       6         Examination       Subject theoretical and practical work	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 coheren report on the project</li> <li>to communicate appropriately and</li> </ul>			
Credit points 6 Examination Subject theoretical and practical work	Autonomy	<ul> <li>work in a team and to organize the</li> </ul>	team themselves		
Examination Subject theoretical and practical work	Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Examination duration	Credit points	6			
Examination duration	Examination	Subject theoretical and practical work			
l several written exams during the semester	Examination duration	several written exams during the semester			



	<u> </u>
and scale	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering
	Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering.
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
Following Curricula	
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Mechanical 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 Compu	iter 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 I Engineering: Compulsory	Enviromental
General Engineering Science (English program, 7 semester): Specialisation Mechanical	Engineering,
Focus Mechatronics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Focus Biomechanics: Compulsory	Engineering,
General Engineering Science (English program, 7 semester): Specialisation Mechanical	Engineering,
Focus Aircraft Systems Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Focus Materials in Engineering Sciences: Compulsory	Engineering,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Focus Theoretical Mechanical Engineering: Compulsory	Engineering,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Focus Product Development and Production: Compulsory	Engineering,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Focus Energy Systems: Compulsory	Engineering,
Computational Science and Engineering: Core qualification: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Logistics and Mobility: Core qualification: Compulsory	
Mechanical Engineering: Core qualification: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Technomathematics: Core qualification: Compulsory	
Process Engineering: Core qualification: Compulsory	



Тур	Lecture	
Hrs/wk	3	
CP	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. Kath Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	<ul> <li>Introduction to Business and Management, Business versus Economics, relevant are 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, S Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply 6 Management, Information Management</li> <li>Definitions as information, information systems, aspects of data security and strainformation systems</li> <li>Definition and Relevance of innovations, e.g. innovation opporunities, risks etc.</li> </ul>	
Literature	<ul> <li>Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008</li> <li>Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003</li> <li>Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.</li> <li>Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001.</li> <li>Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008.</li> <li>Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005.</li> <li>Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.</li> </ul>	



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



/p	Hrs/wk	СР
cture	2	2
ecitation Section (small)	1	1
logy		
the following learning	results	
are renewing rearining	localio	
With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competer in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertaintie and difficulties with their measurement.		
The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby they can develop suitable solutions for managing and mitigatin environmental problems in a business context. They are able to carry out Life Cycle Impar Assessments independently and can apply the software programs OpenLCA and the databas Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.		
The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity and consciousness towards these subjects are raised and which helps to raise their awareness of their future social responsibilities in their role as engineers.		
The students learn to research, process and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business contex and are able to judge results of other publications.		
2		
	_	
n): Specialisation E : Specialisation Proc n, 7 semester): Sp semester): Specialisation compulsory	cess Engine pecialisation ation Proce	eering: Electi n Energy a ss Engineerir
Compt cation:	ulsory Compulsory	ulsory Compulsory

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

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



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



# **Specialization Electrical Engineering**

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

Graduates will have

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (sm	all) 2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathemat	ics I and II		
Educational Objectives	After taking part successfully, students ha	ave reached the following learr	ning results	
Professional Competence				
Knowledge	Students are able to explain the basic methods for calculating electrical circuits. They know the Fourie series analysis of linear networks driven by periodic signals. They know the methods for transient analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.			
Skills	The students are able to calculate cu methods, also when driven by periodic circuits in time and frequency domain ar are able to analyse and to synthesize the	c signals. They are able to ca ad are able to explain the respe	alculate transie	ents in electric behaviour. The
Personal Competence				
Social Competence	Students work on exercise tasks in smal their results within the group.	l guided groups. They are enco	ouraged to pres	ent and discu
Autonomy	The students are able to find out the Possibilities are given to test their know tests. This allows them to control indepen knowledge to other courses like Electrica	edge during the lectures continued and the sector of the s	nuously by mea tives. They can	ans of short-tim



Worklead in Hours Credit points	Independent Study Time 110, Study Time in Lecture 70
	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): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Arne Jacob
Language	DE
Cycle	WiSe
	- Circuit theorems
	- N-port circuits
	- Periodic excitation of linear circuits
Content	- Transient analysis in time domain
	- Transient analysis in frequency domain; Laplace Transform
	- Frequency behaviour of passive one-ports
	- M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)
	- M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)
	- L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
Literature	<ul> <li>- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008)</li> <li>- R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)</li> </ul>
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)



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



Module M0730: Co				
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
A dunia a ia n	None			
Requirements				
	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such the respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the rks are lifted	examination
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence	This module deals with the foundations of the fun	ectionality of computing s	vetome It co	vers the lave
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware 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>			
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the intern structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of today computing systems - from gates and circuits up to complete processors.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly
	Students are able to acquire new knowledge fron with other classes.	n specific literature and t	o associate	this knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

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

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### 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	NiSe	
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

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



Courses					
Title		Тур	Hrs/wk	СР	
	ering I: Time-Independent Fields (L0180) ering I: Time-Independent Fields (L0181)	Lecture Recitation Section (small)	3 2	5 1	
	Prof. Christian Schuster				
Admission Requirements	None				
Recommended Previous Knowledge	Basic principles of electrical engineering an	d advanced mathematics			
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional Competence					
Knowledge	Students can explain the fundamental formulas, relations, and methods of the theory of time independent electromagnetic fields. They can explicate the principal behavior of electrostatic magnetostatic, and current density fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-independent electromagnetic fields and are able to explicate these.				
Skills	Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time independent, electromagnetic field problems. Furthermore, they are capable of applying a variety or methods that require solving Maxwell's Equations for more general problems. The students ca assess the principal effects of given time-independent sources of fields and analyze thes quantitatively. They can deduce meaningful quantities for the characterization of electrostation magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given field and dimension them for practical applications.				
Personal Competence					
Social Competence	Students are able to work together on subject related tasks in small groups. They are able to prese their results effectively (e.g. during exercise sessions).				
Autonomy	Students are capable to gather necessary information from provided references and relate thi information to the lecture. They are able to continually reflect their knowledge by means of activitie that accompany the lecture, such as short oral quizzes during the lectures and exercises that ar related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between their knowledge obtained in this lectur and the content of other lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis).				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70			
Credit points	6				
	Written exam				
Examination duration and scale	90-150 minutes				
Assignment for the Following Curricula	General Engineering Science (German prog General Engineering Science (German pro Compulsory Electrical Engineering: Core qualification: C General Engineering Science (English prog General Engineering Science (English prog	ogram, 7 semester): Specialisa compulsory ram): Specialisation Electrical E	ion Electric	al Engineering	



Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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



Course L0181: Theoretic	cal Electrical Engineering I: Time-Independent Fields
Тур	Recitation Section (small)
Hrs/wk	2
CP	1
	Independent Study Time 2, Study Time in Lecture 28
	Prof. Christian Schuster
Language Cycle	
Cycle	- Maxwell's Equations in integral and differential notation
	<ul> <li>Boundary conditions</li> <li>Laws of conservation for energy and charge</li> </ul>
	- Classification of electromagnetic field properties
	<ul> <li>Integral characteristics of time-independent fields (R, L, C)</li> <li>Generic approaches to solving Poisson's Equation</li> </ul>
Content	- Electrostatic fields and specific methods of solving
	<ul> <li>Magnetostatic fields and specific methods of solving</li> <li>Fields of electrical current density and specific methods of solving</li> </ul>
	- Action of force within time-independent fields
	- Numerical methods for solving time-independent problems
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	<ul> <li>H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)</li> <li>W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)</li> </ul>
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: Ma	terials in Electrical Engineering				
Courses					
Title		Тур	Hrs/wk	CP	
Electrotechnical Experiment		Lecture Lecture	1 2	1	
Materials in Electrical Engine Materials in Electrical Engine	pering (Lucos) pering (Problem Solving Course) (L0687)	Recitation Section (small)	2	3 2	
Module Responsible					
Admission Requirements					
Recommended Previous Knowledge	Highschool level physics and mathematics				
	After taking part successfully, students have rea	ached the following learning	results		
Professional		J J			
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, dielectrical 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 deriv 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 probl within the framework of the problem solving co		esent their re	esults effectively	
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.				
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70			
Credit points	6				
Examination	Written exam				
Examination duration and scale	60 minutes				
	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory				



Tun	Lecture
Hrs/wk	
CP	
	I dependent Study Time 16, Study Time in Lecture 14
	Dr. Wieland Hingst
Language	DE
Cycle	SoSe
	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
Literature	



Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	SoSe
Content	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition. Symmetries, conserved quantities, and the labeling of states. Angular momentum The hydrogen atom Waves in periodic potentials Reciprocal lattice and reciprocal lattice vectors Band gap Band diagrams The free electron gas and the density of states Fermi-Dirac distribution Density of charge carriers in semiconductors Conductivity in semiconductors. Engineering conductivity through doping. The P-N junction (diode) Light emitting diodes Electromagnetic waves interacting with materials Reflection and refraction Photonic band gaps Origins of magnetization Hysteresis in ferromagnetic materials Magnetic domains
Literature	<ol> <li>Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials. Massachusetts Institute of Technology (MIT), 2013</li> <li>Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004</li> <li>Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994</li> <li>Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994</li> <li>Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979</li> <li>Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004</li> <li>Ashcroft, Mermin, Solid State Physics, Harcourt, 1976</li> <li>Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988</li> <li>Sze, Physics of Semiconductor Devices, Wiley, 1981</li> <li>Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007</li> <li>Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 20</li> <li>Handley, Modern Magnetic Materials, Wiley, 2000</li> <li>Wikipedia, Wikimedia</li> </ol>



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)

Γ



<b>Typ</b> Lecture				
	re ation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2	
	(			
s expected. Fur	and systems. Goo Irther experience wi useful but not requir	ith spectral t		
ve reached the	e following learning	results		
The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministi signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal.				
The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain.				
blems.				
	from appropriate lit od by solving tutoria			
in Lecture 56				
	alisation Electrical E			
rogram): Specia rogram): Specia nan program): nan program): nogram): Specia program, 7 sem program, 7 sem rogram, 7 seme rogram, 7 seme	ester): Specialisatio	ngineering: ( s Engineerin Civil- and Mechanical Il Engineerin ion Electrica sation Com ation Proces on Bioproces	Compulsory ng: Compulso Enviroment Engineerin ng: Compulso al Engineerin puter Scienc s Engineerin ss Engineerin al Engineerin	
rogram, 7 ser	n	nester): Specialisatic	nester): Specialisation Bioproces nester): Specialisation Biomedica nester): Specialisation Mechanica	



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



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



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



Module M0709: Ele	ectrical Engineering IV: Transmission	n Lines and Resea	rch Sem	inar
Courses				
<b>Title</b> Research Seminar Electrica Transmission Line Theory ( Transmission Line Theory (	,	<b>Typ</b> Seminar Lecture Recitation Section (large)	Hrs/wk 2 2 2	<b>CP</b> 2 3 1
Module Responsible	Prof. Arne Jacob			
Admission Requirements				
Recommended Previous Knowledge	Electrical Engineering I-III, Mathematics I-III			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students can explain the fundamentals of wave 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 propagation of waves in simple circuits with transmission lines. They are able to analyze circuits in frequency domain and with the Smith chart. They can analyze equivalent circuits of transmission lines. They are able to solve problems including coupled transmission lines using the vectorial transmission line equations. They are able to give a talk to professionals.			
Personal Competence Social Competence	Students can analyze and solve problems in s compare the learned theory with experiments in	the lecture and discuss it		
Autonomy	The students can solve problems by their own ar literature. They are able to test their knowledge us knowledge by answering short questions and te acquired knowledge to other lectures (e.g. Electri familiarize themselves with a research topic and c	sing computer animations sts during the lecture. Th cal Engineering I-III and I	. They can t ney are able Mathematics	est their level of e to relate their
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
	Written exam			
Examination duration and scale	150 min			
	General Engineering Science (German program): General Engineering Science (German program, Compulsory Electrical Engineering: Core qualification: Compu General Engineering Science (English program): General Engineering Science (English program, Compulsory	, 7 semester): Specialisat Isory Specialisation Electrical E	tion Electric	al Engineering: : Compulsory

Technomathematics: Core qualification: Elective Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory

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

Course L0572: Transmission Line Theory		
Тур	Recitation Section (large)	
Hrs/wk	2	
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	



Courses				
Title		Тур	Hrs/wk	СР
	tial Differential Equations) (L1043)	Lecture	2	1
	tial Differential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Par	tial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional				
Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable o 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 M course. Moreover, they are capable</li> <li>Students are able to discover and studied in the course.</li> <li>For a given problem, the students of to critically evaluate the results.</li> </ul>	e of solving them by applying est d verify further logical connect	ablished me ions betwee	thods. In the concept
Personal Competence				
Social Competence	<ul> <li>Students are able to work togeth common language.</li> <li>In doing so, they can communicate partners. Moreover, they can desig peers.</li> </ul>	e new concepts according to the	e needs of th	neir cooperatin
Autonomy	<ul> <li>Students are capable of checking t can specify open questions precise</li> <li>Students have developed sufficient oriented manner on hard problems</li> </ul>	ly and know where to get help in t persistence to be able to work	n solving the	m.
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	erential Equations 2)		



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

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



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

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

Course L1038: Complex	Functions
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>



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

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



Module M0675: Int	roduction to Communications and F	Random Processes	5	
Courses				
Title	inne and Bandam Bransson (1.0442)	Тур	Hrs/wk	<b>CP</b> 4
	ions and Random Processes (L0442) ions and Random Processes (L0443)	Lecture Recitation Section (large)	3 1	4 2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematics 1-3</li> <li>Signals and Systems</li> <li>Basic knowledge of probability theory</li> </ul>			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic communications system.			
Skills	The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method.			
Personal Competence				
Social Competence	The students can 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 Lect	ure 56		
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, 7 semester): Specialisation Electrical Engineering: Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			



Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	WiSe
Content	<ul> <li>Fundamentals of random processes</li> <li>Introduction to communications engineering</li> <li>Quadrature amplitude modulation</li> <li>Description of radio frequency transmission in the equivalent complex baseband</li> <li>Transmission channels, channel models</li> <li>Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM)</li> <li>Fundamentals of information theory, source coding, channel coding</li> <li>Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyque condition, matched filter, detection, error probability</li> <li>Fundamentals of digital modulation</li> </ul>
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner. M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg. J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium. J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill. S. Haykin: Communication Systems. Wiley J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall. J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

Course L0443: Introduct	ourse L0443: Introduction to Communications and Random Processes	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	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	



Courses				
		Tun	Hro huk	СР
Title Electrical Power Systems I (	(1 1670)	<b>Typ</b> Lecture	Hrs/wk 3	4 4
Electrical Power Systems I (	· · · ·	Recitation Section (large)	2	2
_	Prof. Christian Becker			
Admission				
Requirements	None			
Recommended	Fundamentals of Electrical Engineering			
Previous Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional				
Competence				<b>—</b>
Knowledge	Students are able to give an overview of conventional and modern electric power systems. They can explain in detail and critically evaluate technologies of electric power generation, transmission storage, and distribution as well as integration of equipment into electric power systems.			
Skills	With completion of this module the students are able to apply the acquired skills in applications of the design, integration, development of electric power systems and to assess the results.			
Personal Competence				
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 knowledg	e of the emphasis of the lectures.		
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 - 150 minutes			
Assignment for the Following Curricula				



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



Course L1671: Electrica	I Power Systems I
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	DE
Cycle	WiSe
Content	<ul> <li>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 protection</li> <li>grid planning</li> <li>power economy fundamentals</li> </ul> <li>K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage,</li>
Literature	<ul> <li>K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage 2013</li> <li>A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017</li> <li>R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008</li> </ul>



Module M0783: Me	easurements: Methods and Data P	rocessing		
Courses				
Title EE Experimental Lab (L0781 Measurements: Methods an Measurements: Methods an	d Data Processing (L0779)	<b>Typ</b> Practical Course Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1
Module Responsible	Prof. Alexander Schlaefer			
Admission Requirements	None			
Recommended Previous Knowledge	principles of mathematics principles of electrical engineering			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence		a of motivology, and the ope		d avecasias of
Knowledge	The students are able to explain the purpos measurements. They can detail aspects of pro stochastic signals. Students know methods to o	bability theory and errors, an	id explain th	ne processing of
Skills	The students are able to evaluate problems of metrology and to apply methods for describing and processing of measurements.			
Personal Competence				
Social Competence	The students solve problems in small groups.			
Autonomy	The students can reflect their knowledge and c	liscuss and evaluate their res	sults.	
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German progra General Engineering Science (German progra Elective Compulsory Electrical Engineering: Core qualification: Com General Engineering Science (English progra General Engineering Science (English progra Elective Compulsory Computational Science and Engineering: Spec Computational Science and Engineering: Spec Technomathematics: Specialisation III. Engine Technomathematics: Core qualification: Election	am, 7 semester): Specialisa npulsory n): Specialisation Electrical E am, 7 semester): Specialisa cialisation Engineering Scier cialisation Computer Science ering Science: Elective Comp	tion Electric Engineering tion Electric nces: Elective 2: Elective C	al Engineering: : Compulsory al Engineering: re Compulsory



Course 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	WiSe	
Content	lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines	
Literature	Wird in der Lehrveranstaltung festgelegt	

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

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



Courses				
<b>Title</b> Theoretical Electrical Engine	ering II: Time-Dependent Fields (L0182) ering II: Time-Dependent Fields (L0183)	<b>Typ</b> Lecture Recitation Section (sma	Hrs/wk 3 1) 2	<b>CP</b> 5
-	Prof. Christian Schuster		,	
Admission Requirements	None			
	Electrical Engineering I, Electrical Engineer	ng II, Theoretical Electrical E	ngineering I	
Recommended Previous Knowledge	Mathematics I, Mathematics II, Mathematics	III, Mathematics IV		
Educational Objectives	After taking part successfully, students have	reached the following learni	ng results	
Professional Competence		<u> </u>	9	
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory time-dependent electromagnetic fields. They can assess the principal behavior and characteristics quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple field? The students are aware of applications for the theory of time-dependent electromagnetic fields and a able to explicate these.			
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the war equation for general time-dependent field problems. They can assess the principal effects of give time-dependent sources of fields and analyze these quantitatively. They can deduce meaning quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poyntin vector, radiation resistance, etc.) from given fields and interpret them with regard to practic applications.			
Personal Competence				
	Students are able to work together on subj	ect related tasks in small gro	ups. They are	able to prese
Social Competence	their results effectively (e.g. during exercise	sessions).		
Autonomy	Students are capable to gather necessary information from provided references and relate thi information to the lecture. They are able to continually reflect their knowledge by means of activitie that accompany the lecture, such as short oral quizzes during the lectures and exercises that ar related to the exam. Based on respective feedback, students are expected to adjust their individua 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 in	Lecture 70		
Credit points				
	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the	General Engineering Science (German prog General Engineering Science (German pro Compulsory Electrical Engineering: Core qualification: C General Engineering Science (English prog	ogram, 7 semester): Speciali ompulsory	sation Electric	al Engineerin



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

 Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

 Technomathematics: Core qualification: Elective Compulsory

Тур	Lecture	
Hrs/wk	3	
CP	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Christian Schuster	
Language		
Cycle		
	- Theory and principal characteristics of quasistationary electromagnetic fields	
	- Electromagnetic induction and law of induction	
	- Skin effect and eddy currents	
	- Shielding of time variable magnetic fields	
	- Theory and principal characteristics of fully dynamic electromagnetic fields	
	- Wave equations and properties of planar waves	
Content	- Polarization and superposition of planar waves	
	- Reflection and refraction of planar waves at boundary surfaces	
	- Waveguide theory	
	- Rectangular waveguide, planar optical waveguide	
	- Elektrical and magnetical dipol radiation	
	- Simple arrays of antennas	
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)	
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)	
Literature	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)	
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)	
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)	
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)	



urse L0183: Theoretic	cal Electrical Engineering II: Time-Dependent Fields
Тур	Recitation Section (small)
Hrs/wk	2
CP	
	Independent Study Time 2, Study Time in Lecture 28
	Prof. Christian Schuster
Language Cycle	
Cycle	- Theory and principal characteristics of quasistationary electromagnetic fields
	- Electromagnetic induction and law of induction
	- Skin effect and eddy currents
	- Shielding of time variable magnetic fields
	- Theory and principal characteristics of fully dynamic electromagnetic fields
	- Wave equations and properties of planar waves
Content	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
Literature	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)



Module M0760: Ele	ectronic Devices			
Courses				
Title Electronic Devices (L0720)		<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Electronic Devices (L0721)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Hoc Khiem Trieu			
Admission Requirements	None			
Recommended Previous Knowledge	Atomic model and quantum theory, electrical currents in solid state materials, basics in solid-stat physics Successful participation of Physics for Engineers and Materials in Electrical Engineering or course with equivalent contents			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence	-			
Knowledge	<ul> <li>Students are able</li> <li>to represent the basics of semiconductor physics,</li> <li>to explain the operating principle of important semiconductor devices,</li> <li>to outline device characteristics and equivalent circuits as well as to explain their derivation and</li> <li>to discuss the limitation of device models.</li> </ul>			
Skills	<ul> <li>Students are capable</li> <li>to apply devices in basic circuits,</li> <li>to realize the physical context and to solve complex problems by oneself</li> </ul>			
Personal Competence				
Social Competence	Students are able to prepare and perform the discuss the results in front of audience.	neir lab experiments in team wo	ork as well as	s to present an
Autonomy	Students are capable to acquire knowledge	e based on literature in order to	prepare thei	r experiments.
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 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 Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory			

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



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



Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible				
Admission				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and system	ns in time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students	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 terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence		to jointly solve technical problems, a	and experim	entally validat
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study T	Time in Lecture 56		
Credit points				
-	Written exam			
Examination duration and scale				
	General Engineering Science (Gen Compulsory	an program): Core qualification: Comp man program, 7 semester): Special an program, 7 semester): Specialisatio	isation Com	

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



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

	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Signals and systems   Linear systems, differential equations and transfer functions  First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle  Root locus techniques  Root locus plots Not locus design of PID controllers  Frequency response techniques  Not locus techniques  Not locus at a lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Reference tracking, and frequency response of time delay systems Software tools Not locus and frequency response of time delay systems Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



Course L0655: Introduct	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	



Courses				
Title Semiconductor Circuit Desiç	gn (L0763)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Semiconductor Circuit Desig	ın (L0864)	Recitation Section (smal	) 1	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge		Fundamentals of electrical engineering Basics of physics		
Educational Objectives	After taking part successfully, students	s have reached the following learning	ng results	
Professional Competence		¥		
Knowledge	<ul> <li>Students are able to explain the functionality of different MOS devices in electronic circuits.</li> <li>Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.</li> <li>Students have solid knowledge about memory circuits and can explain their functionality and specifications.</li> <li>Students are able to explain how analog circuits functions and where they are applied.</li> <li>Students know the appropriate fields for the use of bipolar transistors.</li> </ul>			
Skills	<ul> <li>Students can calculate the specifications of different MOS devices and can define th parameters of electronic circuits.</li> <li>Students are able to develop different logic circuits and can design different types of logi circuits.</li> <li>Students can use MOS devices, operational amplifiers and bipolar transistors for specifi applications.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able work efficiently in heterogeneous teams.</li> <li>Students working together in small groups can solve problems and answer professiona questions.</li> </ul>			
Autonomy	<ul> <li>Students are able to assess the</li> </ul>	eir level of knowledge.		
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 (Germa General Engineering Science (Germ Mechatronics: Compulsory General Engineering Science (Germa Compulsory General Engineering Science (Germa Focus Mechatronics: Compulsory	nan program): Specialisation Me an program, 7 semester): Speciali	chanical Eng	ineering, Focu cal Engineerin



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

Course L0763: Semiconductor Circuit Design				
Тур	Lecture			
Hrs/wk	3			
СР	4			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Matthias Kuhl			
Language	DE			
Cycle	SoSe			
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul> From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.).			
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 201 ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik un Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflag 2012, ISBN 3540428496</li> </ul>			



Course L0864: Semiconductor Circuit Design				
Typ Recitation Section (small)				
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Matthias Kuhl			
Language	DE			
Cycle	SoSe			
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul>			
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 201 ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik un Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflag 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Ber 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/book/index.cfm/bok_id/319955</li> </ul>			



Previous KnowledgeEducational ObjectivesAfter taking pairProfessional CompetenceAfter taking this Management, and ControllingKnowledgeAfter taking this Management, and ControllingKnowledgeexplain Manage e explain aspects describ supply manage e explain multiple Finance e state baseKnowledgeStudents are a strategies etc.)SkillsStudents are a strategies etc.)Personal CompetenceStudents are al select a e apply bSocial CompetenceStudents are al sto coopAutonomyStudents are al students are al e apply b	of Management			
Title         Introduction to Management (L0880)         Project Entrepreneurship (L0880)         Module Responsible       Prof. Christoph         Admission       None         Recommended       Basic Knowled         Previous Knowledge       After taking part         Professional       After taking this         Competence       After taking this         Management, and Controlling <ul> <li>explain Manage</li> <li>explain M</li></ul>				
Admission RequirementsNoneRecommended Previous KnowledgeBasic KnowledgeEducational ObjectivesAfter taking part Management, and ControllingProfessional CompetenceAfter taking this Management, and ControllingKnowledgeAfter taking this Management, and ControllingKnowledgeStilleSkillsStudents are a strategies etc.)Personal CompetenceStudents are a strategies etc.)Personal CompetenceStudents are a strategies etc.)Social CompetenceStudents are a students are a strategies etc.)AutonomyStudents are a students are a strategies etc.)		<b>Typ</b> Lecture Project-/problem-based Learning	<b>Hrs/wk</b> 3 2	<b>CP</b> 3 3
Admission RequirementsNoneRecommended Previous KnowledgeBasic KnowledgeEducational ObjectivesAfter taking part Management, and ControllingProfessional CompetenceAfter taking this Management, and ControllingKnowledgeAfter taking this Management, and ControllingKnowledgeStilleSkillsStudents are a strategies etc.)Personal CompetenceStudents are a strategies etc.)Personal CompetenceStudents are a strategies etc.)Social Competence coup coup coup coup coup coup coup coup coup 	11. 1	Learning		
Recommended Previous KnowledgeBasic KnowledgeEducational ObjectivesAfter taking partProfessional CompetenceAfter taking this Management, and ControllingKnowledge- explain Manage - explain aspects - explain aspects - explain aspects - explain aspects - explain aspects - explain multiple Finance - explain multiple - explain aspects - explain - explain aspects - explain aspects - explain aspects - explain aspects - explain aspects - explain aspects - explain aspects - explain aspects - explain aspects - explain - explain 	INI			
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CompetenceAfter taking this Management, and Controlling • explain aspects • describ supply manage • explain aspects • describ supply manage • explain multiple Finance • state barKnowledgeStudents are a strategies etc.)SkillsStudents are a strategies etc.)Personal CompetenceStudents are al select a • apply bSocial CompetenceStudents are al • to comp • to comp • to compAutonomyStudents are al • work in	successfully, students have re	eached the following learning	g results	
Management, and ControllingKnowledgeexplain Manage explain aspects describ supply manage explain multiple Finance e state baseKnowledgeexplain Manage explain multiple Finance e state baseSkillsStudents are a strategies etc.)SkillsStudents are a strategies etc.)Personal CompetenceStudents are a select a e apply m e analyse e select a e apply bPersonal CompetenceStudents are a strategies etc.)Social CompetenceStudents are a e opply report of e to comp e to compStudents are a students are a e apply bStudents are a e opply report of e to compStudents are a e opply report of e to compStudents are a e opply report of e to compStudents are a e opply report of e to compAutonomywork in		an automatic stranger diff		
Skillsstrategies etc.)Skills• analyseSkills• apply manalyse• apply manalyse• apply m• analyse• analyse• apply b• apply bPersonal Competence• work suSocial Competence• work su• to apply report of• to comm• to comp• to comm• to coop• Students are alAutonomy• work in	<ul> <li>Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management and marketing</li> </ul>			
Social Competence       Students are al         Social Competence       • work su         • to apply report of to comm         • to coop         Students are al         Autonomy         • work in	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Social Competence • work su • to apply report of • to comm • to coop Students are al Autonomy • work in				
Autonomy • work in	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a coherer report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours Independent S	udy Time 110, Study Time in L	ecture 70		
Credit points 6				
Examination Subject theore	cal and practical work			
Examination duration several written	exams during the semester			



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

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



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



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



Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering Project Laboratory (L0640)		Project-/problem-based Learning	5	6
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
	Electrical Engineering I, Electrical Engineerin	g II		
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning	g results	
Professional Competence				
	Students are able to give a summary of the technical details of projects in the area of electrica engineering and illustrate respective relationships. They are capable of describing an communicating relevant problems and questions using appropriate technical language. They ca explain the typical process of solving practical problems and present related results.			
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process solving practical problems. They identify and overcome typical problems during the realization projects in the context of electrical engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems.			
Personal Competence		nived-subject groups in or	ter to indep	andently deriv
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derives solutions to given problems in the context of electrical engineering. They are able to effectively prese and explain their results alone or in groups in front of a qualified audience. Students have the ability develop alternative approaches to an electrical engineering problem independently or in groups are discuss advantages as well as drawbacks.			
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and othe sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.			
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Examination	Subject theoretical and practical work			
Examination duration and scale	based on task + presentation			
Assignment for the Following Curricula		ram, 7 semester): Specialis mpulsory m): Specialisation Electrical	ation Electric Engineering	al Engineering : Compulsory



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

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



## **Specialization Energy and Enviromental Engineering**

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

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

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

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

Module M0730: Co	omputer Engineering		
Courses			
Title	Тур	Hrs/wk	СР
Computer Engineering (L03) Computer Engineering (L03)		3 all) 1	4 2
Module Responsible	Prof. Heiko Falk		
Admission Requirements	None		
Recommended Previous Knowledge		a bonus on th marks are lifte	e examination
Educational Objectives	After taking part successfully, students have reached the following learn	ing results	
Professional Competence		des the followir	ng topics:



Knowledge	<ul> <li>recrimological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul>
	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors.
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	
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 knowledge with other classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
	Written exam
Examination duration	
and scale	90 minutes, contents of course and labs
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation 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 Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental 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 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 Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory



	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical 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			
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		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0933: Fu	Indamentals of Materials Science			
0				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials		Lecture	2	2
Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
	ics of Materials Science (L1095)	Lecture	2	2
	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge		tics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge	describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.			
Skills	The students are able to trace materials 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 or the material's behavior.			
Personal Competence				
Social Competence				
Autonomy				
-	I Independent Study Time 96, Study Time in Lecture	84		
Credit points				
	Written exam			
Examination duration	 180 min			
and scale	General Engineering Science (German prog	ram): Specialization E	neray and	Enviroment
	Engineering: Compulsory		anu anu	
	General Engineering Science (German pro	gram): Specialisation	Mechanical	Engineering
	Compulsory	Openialization D'accord	L Engeling to t	
	General Engineering Science (German program): General Engineering Science (German program):	-	-	
	General Engineering Science (German program). General Engineering Science (German program, 7			
	Compulsory			
	General Engineering Science (German program, 7	7 semester): Specialisatio	on Biomedic	al Engineering
	Compulsory General Engineering Science (German program Compulsory			
	General Engineering Science (German prog Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qua		pecialisation	Energy an
	[001]			



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

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

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



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



Courses				
Title Embodiment Design and 3D Mechanical Design Project I Mechanical Design Project I Team Project Design Metho	(L0695) I (L0592)	<b>Typ</b> Lecture Practical Course Practical Course Project-/problem Learning	e 3	<b>CP</b> 1 2 2 1
Module Responsible	Prof. Dieter Krause	Loannig		
Admission				
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>			
Educational Objectives	After taking part successfully, students h	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	<ul> <li>After passing the module, students are able to:</li> <li>independently create sketches, technical drawings and documentations e.g. using 3D CAD,</li> <li>design components based on design guidelines autonomously,</li> <li>dimension (calculate) used components,</li> <li>use methods to design and solve engineering design tasks systamtically and solution-oriented,</li> <li>apply creativity techniques in teams.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>After passing the module, students are able to:</li> <li>develop and evaluate solutions in groups including making and documenting decisions,</li> <li>moderate the use of scientific methods,</li> <li>present and discuss solutions and technical drawings within groups,</li> <li>reflect the own results in the work groups of the course.</li> </ul>			
Autonomy	<ul> <li>Students are able</li> <li>to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),</li> <li>To solve engineering design tasks systematically.</li> </ul>			
	Independent Study Time 40, Study Time	e in Lecture 140		
Credit points				
Examination Examination duration and scale				
	General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Compulsory General Engineering Science (German General Engineering Science (German	rman program): Specia program): Specialisation I	alisation Mechanic Biomedical Enginee	al Engineering ring: Compulsor



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

Course L0268: Embodiment Design and 3D-CAD			
Typ Lecture			
Hrs/wk	2		
СР	<b>CP</b> 1		
Workload in Hours	rkload in Hours Independent Study Time 2, Study Time in Lecture 28		
Lecturer	turer 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	Typ Practical Course		
Hrs/wk	3		
СР	2		
Workload in Hours	ndependent Study Time 18, Study Time in Lecture 42		
Lecturer	Prof. Thorsten Schüppstuhl		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Create a technical documentation of an existing mechanical model</li> <li>Consolidation of the following aspects of technical drawings:         <ul> <li>Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts)</li> <li>Sectional views</li> <li>Dimensioning</li> <li>Tolerances and surface specifications</li> <li>Creating a tally sheet</li> </ul> </li> </ul>		
Literature	<ol> <li>Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011.</li> <li>Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008.</li> <li>Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005.</li> </ol>		

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



Course L0267: Team Project Design Methodology			
Typ Project-/problem-based Learning			
Hrs/wk	Hrs/wk 2		
CP 1			
Workload in Hours	Workload in Hours Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		

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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	<ul> <li>Mathematics I+II+III</li> <li>Technical Mechanics I+II</li> <li>Technical Thermodynamics I+II</li> <li>Working with force balances</li> <li>Simplification and solving of partial</li> <li>Integration</li> </ul>	differential equations		
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to:</li> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in process engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions</li> </ul>			
Skills	<ul> <li>The students are able to</li> <li>describe and model incompressibl</li> <li>reduce the governing equations of solutions e.g. by integration</li> <li>notice the dependency between th</li> <li>use the learned basics for fluid dyn</li> </ul>	of fluid mechanics by simplificat		·
Personal Competence				
Social Competence	<ul> <li>The students</li> <li>are capable to gather information frinformation to the context of the lect</li> <li>able to work together on subject results effectively in English (e.g. d)</li> <li>are able to work out solutions for expresent the results.</li> </ul>	ture and elated tasks in small groups. Th uring small group exercises)	ey are able	to present the
Autonomy	<ul> <li>The students are able to</li> <li>search further literature for each to</li> <li>work on their exercises by their ow</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engineering: Compulsory General Engineering Science (German p	ogram): Specialisation Bioproces n program): Specialisation I	ss Engineeri Energy and	ng: Compulso I Enviromenta



Assignment for the Following Curricula	I Energy and Environmental Engineering. Core qualification: Compulsory
	Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core gualification: Compulsory

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



Course L0092: Fluid Med	chanics for Process Engineering	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Michael Schlüter	
Language	DE	
Cycle	SoSe	
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into pplication. For that, the students receive example tasks for download. The students solve these roblems based on the lecture material either independently or in small groups. The solution is iscussed 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 oard. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under 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				
Fitle		Тур	Hrs/wk	СР
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	NN			
Admission	J			
Requirements				
Recommended	Basics of mathematics, in particular complex	e numbers, integrals, differenti	als	
	Basics of electrical engineering and mechar	nical engineering		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional	· · · ·			
Competence				
	Students can to draw and explain the basic	principles of electric and magn	etic fields.	
Knowledge	They can describe the function of the corresponding equations and characteristic major parameters of the energy efficiency	c curves. For typically used d	rives they c	an explain i
	engine.		o power giv	
	Students arw able to calculate two-dimensio	anal alastria and magnetic fields	in particula	r forromagn
	circuits with air gap. For this they apply the u	-		-
0.11	They can calulate the operational performan			aracteristic d
Skills	land selected quantities and characteristic			
		c curves. They apply the usu	ial equivale	nt circuits a
	graphical methods.	c curves. They apply the usu	ial equivale	nt circuits a
		c curves. They apply the usu	ial equivale	nt circuits a
Personal Competence	graphical methods.	c curves. They apply the usu	ial equivale	nt circuits a
Personal Competence Social Competence	graphical methods.	c curves. They apply the usu	ial equivale	nt circuits a
Personal Competence Social Competence	graphical methods. none Students are able independently to calcula	ate electric and magnatic fields	s for applica	tions. They a
Social Competence	graphical methods. none Students are able independently to calcula able to analyse independently the operation	ate electric and magnatic fields al performance of electric mach	s for applica nines from th	tions. They a
-	graphical methods. none Students are able independently to calcula able to analyse independently the operation	ate electric and magnatic fields al performance of electric mach	s for applica nines from th	tions. They a
Social Competence	graphical methods. none Students are able independently to calcula able to analyse independently the operation	ate electric and magnatic fields al performance of electric mach	s for applica nines from th	tions. They a
Social Competence Autonomy	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu	s for applica nines from th	tions. They a
Social Competence Autonomy	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu	s for applica nines from th	tions. They a
Social Competence Autonomy Workload in Hours Credit points	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu	s for applica nines from th	tions. They a
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu	s for applica nines from th	tions. They a
Social Competence Autonomy Workload in Hours Credit points Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70	s for applica nines from th nrves.	tions. They a le characters
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70	s for applica nines from th nrves.	tions. They a le characters
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro-	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E	s for applica hines from th irves.	tions. They a le characters
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E ogram): Specialisation Mechar	s for applica nines from th rves.	tions. They a le characters Enviromer eering: Elect
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E ogram): Specialisation Mechar	s for applica nines from th rves.	tions. They a le characters Enviromer eering: Elect
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E ogram): Specialisation Mechan program, 7 semester): Sp	s for applica nines from th rves. Energy and nical Engine pecialisation	tions. They a le characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German prog Elective Compulsory	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E ogram): Specialisation Mechan program, 7 semester): Sp gram, 7 semester): Specialisatic	s for applica nines from th rves. Energy and nical Engine pecialisation	tions. They a le characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination Examination	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German prog Elective Compulsory Electrical Engineering: Core qualification: El	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E ogram): Specialisation Mechan program, 7 semester): Sp gram, 7 semester): Specialisatic lective Compulsory	s for applica nines from th rves. Energy and nical Engine pecialisation	tions. They a le characters Enviromer eering: Elect Energy a
Social Competence Autonomy Workload in Hours Credit points Examination Examination and scale	graphical methods. none Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time in 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German prog Elective Compulsory Electrical Engineering: Core qualification: El Energy and Environmental Engineering: Core	ate electric and magnatic fields al performance of electric mach quantities and characteristic cu Lecture 70 program): Specialisation E ogram): Specialisation Mechan program, 7 semester): Sp gram, 7 semester): Specialisatic lective Compulsory re qualification: Compulsory	s for applica hines from th rves. Energy and nical Engine pecialisation on Mechanic	tions. They a le characters Enviromer eering: Elect Energy a al Engineeri
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
Mechanical Engineering: Core qualification: Elective Compulsory Mechatronics: Core qualification: Compulsory

Course L0293: Electrical Machines				
Тур	Lecture			
Hrs/wk	3			
СР	4			
Workload in Hours         Independent Study Time 78, Study Time in Lecture 42           Lecturer         Trung Do Thanh				
		Language	DE	
Cycle	SoSe			
	Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force			
	Magnetic field: force, flux line, Ampere's law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer			
	DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation,			
	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			
	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	Typ       Recitation Section (large)         s/wk       2         CP       2			
Hrs/wk				
СР				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Trung Do Thanh, Weitere Mitarbeiter			
Language	DE			
Cycle	SoSe			
Content	Exercises to the application of electric and magnetic fields. Excercises to the operational performance of eletric machines.			
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"			



Module M0618: Re	newables and Energy Systems			
Courses				
Title Power Industry (L0316) Energy Systems and Energy	( Industry (I 0315)	<b>Typ</b> Lecture Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 2
Renewable Energy (L0313) Renewable Energy (L1434)		Lecture Recitation Section (small)	2	2
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements				
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have re-	ached the following learning	results	
Professional Competence				
Knowledge	With completion of this module, the students systems and their economic efficiency. The Furthermore, they can explain details of power regard to subject-related contexts. The student many energy systems in general, especially for Furthermore, the students can explain the envir	ey can explain the issues or generation, power distribut nts can explain these aspect or renewable energy systems	occurring tion and po ts, which a s and critica	in this context wer trading wil 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 system 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.			
Personal Competence	renewable energies orally and to put them the	m into the right context.		
Social Competence	The students are able to analyze suitable teo economical and ecological criteria under susta contribuition to a more sustainable power supp	ainability aspects. This allows		
Autonomy	Students can independently exploit sources , a and transform it to new questions.	acquire the particular knowle	dge about t	he subject are
Workload in Hours	Independent Study Time 96, Study Time in Leo	cture 84		
Credit points	6			
	Written exam			
Examination duration and scale	3 hours written exam			
	General Engineering Science (German p Engineering: Compulsory General Engineering Science (German p Enviromental Engineering: Compulsory General Engineering Science (German progra Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core General Engineering Science (English p Engineering: Compulsory General Engineering Science (English program	orogram, 7 semester): Sp um, 7 semester): Specialisatio qualification: Compulsory orogram): Specialisation E	n Mechanic nergy anc	n Energy and cal Engineering I Enviromenta



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

Course L0316: Power In	dustry
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> </ul>
Literature	Folien der Vorlesung

Course L0315: Energy S	ystems 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: Renewab	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 - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

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



Measurement Technology for         Module Responsible       D         Admission       Requirements         Recommended       P         Previous Knowledge       A         Educational Objectives       A         Competence       S         Knowledge       T         Knowledge	t and Control Systems (L1119) Mechanical and Process Engineers (L1116) Mechanical and Process Engineers (L1118) Sven Krause one asic knowledge of physics, chemistry and electer taking part successfully, students have re- udents are able to name the most implicantities and Units, Uncertainty, Calibrat restems). Mey can outline the most important meas assured (Electrical Quantities, Temperature rey can describe important methods of momatography) udents can select suitable measuring easurement devices in practice. Me students are able to orally explain issue lution approaches as well as place the issue	pached the following learning portant fundmentals of the tion, Static and Dynamic f muring methods for different mechanical quantities, Flow chemical Analysis (Gas Se methods to given problem es in the subject area of me	Measureme Properties o t kinds of q v, Time, Freq ensors, Spea ns and can easurement t	If Sensors an uantities to b uency). ctroscopy, Ga use referin technology an
Admission Requirements       N         Recommended Previous Knowledge       A         Educational Objectives       A         Professional Competence       S         Knowledge       N         Knowledge       N      K	asic knowledge of physics, chemistry and ele- ter taking part successfully, students have re- udents are able to name the most imp uantities and Units, Uncertainty, Calibrat rstems). They can outline the most important meas assured (Electrical Quantities, Temperature rey can describe important methods of momatography) udents can select suitable measuring easurement devices in practice. The students are able to orally explain issue lution approaches as well as place the issue	pached the following learning portant fundmentals of the tion, Static and Dynamic f muring methods for different mechanical quantities, Flow chemical Analysis (Gas Se methods to given problem es in the subject area of me	Measureme Properties o t kinds of q v, Time, Freq ensors, Spea ns and can easurement t	If Sensors an uantities to b uency). ctroscopy, Ga use referin technology an
Admission Requirements       N         Recommended Previous Knowledge       A         Educational Objectives       A         Professional Competence       S         Knowledge       N         Knowledge       N      K	asic knowledge of physics, chemistry and ele- ter taking part successfully, students have re- udents are able to name the most imp uantities and Units, Uncertainty, Calibrat rstems). They can outline the most important meas assured (Electrical Quantities, Temperature rey can describe important methods of momatography) udents can select suitable measuring easurement devices in practice. The students are able to orally explain issue lution approaches as well as place the issue	pached the following learning portant fundmentals of the tion, Static and Dynamic f muring methods for different mechanical quantities, Flow chemical Analysis (Gas Se methods to given problem es in the subject area of me	Measureme Properties o t kinds of q v, Time, Freq ensors, Spea ns and can easurement t	If Sensors an uantities to b uency). ctroscopy, Ga use referin technology an
Previous Knowledge Educational Objectives A Professional Competence Knowledge T Knowledge T S S S S S S S S S S S S S	ter taking part successfully, students have re udents are able to name the most imp uantities and Units, Uncertainty, Calibrat rstems). They can outline the most important meas assured (Electrical Quantities, Temperatures they can describe important methods of momatography) udents can select suitable measuring easurement devices in practice. The students are able to orally explain issue lution approaches as well as place the issue	pached the following learning portant fundmentals of the tion, Static and Dynamic f muring methods for different mechanical quantities, Flow chemical Analysis (Gas Se methods to given problem es in the subject area of me	Measureme Properties o t kinds of q v, Time, Freq ensors, Spea ns and can easurement t	If Sensors an uantities to b uency). ctroscopy, Ga use referin technology an
Professional Competence       S         Knowledge       T         Knowledge       T         Knowledge       T         Knowledge       T         Skills       S         Personal Competence       S         Social Competence       S         Autonomy       S         Querkload in Hours       In         Credit points       G         Examination duration       In         and scale       In         G       G	udents are able to name the most impluantities and Units, Uncertainty, Calibrat rstems). They can outline the most important meas assured (Electrical Quantities, Temperature) rey can describe important methods of momatography) udents can select suitable measuring easurement devices in practice. The students are able to orally explain issue lution approaches as well as place the issue	portant fundmentals of the tion, Static and Dynamic f muring methods for different mechanical quantities, Flow chemical Analysis (Gas Se methods to given problen es in the subject area of me	Measureme Properties o t kinds of q v, Time, Freq ensors, Spea ns and can easurement t	If Sensors an uantities to b uency). ctroscopy, Ga use referin technology an
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Personal Competence Social Competence Social Competence Autonomy Workload in Hours Credit points Examination duration and scale	easurement devices in practice. The students are able to orally explain issue lution approaches as well as place the issue	es in the subject area of me	easurement t	technology a
Social Competence Autonomy Workload in Hours Credit points Examination and scale	udents can arrive at work results in groups of			
Autonomy S Workload in Hours In Credit points 6 Examination W Examination duration and scale	adonto dan anne al work results in groups d	and document them in a comr	mon report.	
Workload in Hours       In         Credit points       6         Examination       W         Examination duration and scale       1         G       G         E       G         G       G      <				
Credit points 6 Examination W Examination duration and scale E G G	udents are able to familiarize themselves wi		logies.	
Examination W Examination duration and scale G E G G	dependent Study Time 110, Study Time in L	ecture 70		
Examination duration and scale E G G	ritten evam			
E G	5 minutes			
G G G E G C G C G C C G C C C C	eneral Engineering Science (German agineering: Compulsory eneral Engineering Science (German ompulsory eneral Engineering Science (German progra eneral Engineering Science (German progra eneral Engineering Science (German aviromental Engineering: Compulsory eneral Engineering Science (German progra ompulsory eneral Engineering Science (German progra ompulsory eneral Engineering Science (German progra ompulsory eneral Engineering Science (German progra ompulsory	program): Specialisation am): Specialisation Biomedica am): Specialisation Process E program, 7 semester): Sp am, 7 semester): Specialisation am, 7 semester): Specialisation am, 7 semester): Specialisation	Mechanical al Engineerirg Engineering: pecialisation on Mechanic	I Engineerir ng: Compulsor Compulsory Energy a al Engineerir al Engineerir
	ergy and Environmental Engineering: Core	qualification: Compulsory program): Specialisation E	Enoraly and	



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



Course L1119: Practical	Course: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
CP	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
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>
Literature	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	<ul> <li>Versuch 4:</li> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



ourse L1116: Measure	ment Technology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	2
СР	
	Independent Study Time 62, Study Time in Lecture 28
	Dr. Sven Krause
Language	
Cycle	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
Content	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springe 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 97 3486217940.



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



Courses				
<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
Module Responsible			_	-
Admission Requirements				
-	Fundamentals of inorganic/organic chemis	stry and biology		
Educational Objectives	After taking part successfully, students hav	e reached the following lea	arning results	
Professional Competence				
Knowledge	With the completion of this modul the students obtain profound knowledge of environmenta technology. They are able to describe the behaviour of chemicals in the environment. Students car give an overview of scientific disciplines involved. They can explain terms and allocate them to related methods.			
Skills	Students are able to propose appropriate problems. They are able to determine pollutants to migrate and transform. The s Environmental Technology contributes to these opinons in front of and against the g	geochemical parameters tudents are able to work o sustainable development,	and to assess out well founded c	the potential pinions on ho
Personal Competence				
Social Competence	The students are able to discuss the vari- multidisciplinary. They are able to develo discuss their theoretical or practical impler	p different approaches to		
Autonomy	Students can independently exploit source tranfer it to new problems.	es about of the subject, acq	uire the particular	knowledge a
Workload in Hours	Independent Study Time 48, Study Time in	Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Electiv Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective 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): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environment 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

TUHH

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

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



Courses				
<b>Title</b> Heat and Mass Transfer (LC Heat and Mass Transfer (LC		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 1	<b>CP</b> 2 2
Heat and Mass Transfer (L1	868)	Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge: Technical Thermodyna	amics		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of expla procedural apparatus (e. g. heat e</li> <li>They are capable of distinguish namely heat conduction, heat trar</li> <li>The students have the ability to describe mass transfer qualitative</li> <li>They are able to depict the analo linked processes in detail.</li> </ul>	exchanger, chemical reactors). and characterize different kinds o nsfer and thermal radiation. explain the physical basis for ma and quantitative by using suitable	f heat transf ss transfer mass trans	fer mechanisn in detail and fer theories.
Skills	<ul> <li>respectively.</li> <li>They are capable to solve spectemperature alteration in fluids) and</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish betwork they can use this knowledge for column, rectification column).</li> <li>In this context, the students are compass exchanger for a specific a respectively.</li> <li>In addition, they can calculate box apparatus.</li> <li>The students are capable to context are compassed and context.</li> </ul>	nd to balance the correspondin cific heat transfer problems (e.g. nd to calculate the corresponding h he students can execute scaling u ween diffusion, convective mass tr for the description and design of capable to choose and design fun- pplication considering their advant th, steady-state and non-steady-state nect their knowledge obtained in the courses thermodynamics, fluid	g energy a heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate processe his course	and mass flo emical reactor cal processes d mass transfe (e.g. extraction pes of heat ar disadvantage es in procedur with knowlego
Personal Competence Social Competence	<ul> <li>The students are capable to wor results orally in a reasonable mar</li> </ul>		n teams and	d to present th
	<ul> <li>The students are able to find and</li> <li>They are able to prove their I procedure continuously (clicker-state)</li> </ul>		course with	accompanyir



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



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

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

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

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Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Process	ses (L0118)	Lecture	2	2
Thermal Separation Process	ses (L0119)	Recitation Section (small)	2	2
Thermal Separation Process		Recitation Section (large)	1	1
Separation Processes (L115	59)	Practical Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodyna	mics III		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>distillation, extraction, and adsorption</li> <li>The students develop an understanding for the course of concentration during a separa process, the estimation of the energy demand of a process, the possibilities of energy sav and the selection of separation systems</li> <li>They have good knowledge of designing methods for separation processes and devices</li> </ul>		energy savin	
Skills	<ul> <li>Using the gained knowledge the students can select a reasonable system boundary for a gi 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 proces 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 ba on the advantages and disadvantages of the process</li> <li>The students are capable to obtain independently the needed material properties f 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 experimental work with the teachers in colloquium.</li> </ul>		aration proce ven case base properties fro ab work. content of th ectures and u	
Personal Competence	<ul> <li>The students can work technical a</li> </ul>	assignments in small groups a	and presen	t the combine
Social Competence	<ul> <li>results in the tutorial</li> <li>The students are able to carry out p division of labor between them. The scientifically in a report.</li> </ul>		-	
Autonomy	<ul> <li>The students are capable to obt themselves and assess their quality</li> <li>The students can proof the state of t this way control their learning process</li> </ul>	heir knowledge with exam rese		



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



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



Course L0119: Thermal	Separation Processes	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction in the thermal process engineering and to the main features of separation processes</li> <li>Simple equilibrium processes, several steps processes</li> <li>Distillation of binary mixtures, enthalpy-concentration diagrams</li> <li>Extractive and azeotrope distillation, water vapor distillation, stepwise distillation</li> <li>Extraction: separation ternary systems, ternary diagram</li> <li>Multiphase separation including complex mixtures</li> <li>Designing of separation devices without discrete stages</li> <li>Drying</li> <li>Chromatographic separation processes</li> <li>Membrane separation</li> <li>Energy demand of separation processes</li> <li>Advance overview of separation processes</li> <li>Selection of separation processes</li> <li>The students work on tasks in small groups and present their results in front of all students.</li> </ul>	
Literature	<ul> <li>G. Brunner: Skriptum Thermische Verfahrenstechnik</li> <li>J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980</li> <li>Sattler: Thermische Trennverfahren, VCH, Weinheim 1995</li> <li>J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998.</li> <li>Mersmann: Thermische Verfahrenstechnik, Springer, 1980</li> <li>Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 .</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie</li> </ul>	



Тур	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 of Gruyter, Berlin 1997</li> <li>Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 7985-0944-1; ISBN 0-387-91477-3.</li> <li>R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006.</li> <li>Perry's Chemical Engineers'' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th endocymentality.</li> </ul>	



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



Courses				
<b>Title</b> Gas and Steam Power Plan Gas and Steam Power Plan		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 2	<b>CP</b> 4 2
Module Responsible	Prof. Alfons Kather			
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>"Technical Thermodynamics I a</li> <li>"Heat Transfer"</li> <li>"Fluid Mechanics"</li> </ul>	and II"		
Educational Objectives	After taking part successfully, students	have reached 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 conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage.			
	The students have basic knowledge a		-	-
Skills	The students will be able, using theor based on well-founded knowledge on identify basic associations in the pro- solutions. Through analysis of the pro- power generation the students are en optimal concepts for the generation of the students become the ability to fo within the energy-political triangle (eco	the function and construction of gas oduction of heat and electricity, so oblem and exposure to the inherent dowed with the capability and meth f electricity and the production of heat llow better the deliberations on the phonomy, secure supply and environme	and steam as to deve interplay be odology to c at. From the t electricity n ental protecti	bower plants, elop conceptu- tween heat an levelop realist echnical basic nix compositic on).
	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 highligh aspects of the design and development of power plant cycles.			
	The students are able to do simplifie single component or at stage level.	ed calculations on turbomachinery e	either as pai	t of a plant, a
Personal Competence				
Social Competence	An excursion within the framework of students get in this manner direct con obtain first-hand experience with a between technical and political issues	tact with a modern power plant in the power plant in operation and gair	nis region. T	he students w
Autonomy	The students assisted by the tutors will be able to develop alone simple simulation models and rul 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 condition highlighted. The students are able independently to analyse the operational performance of stear power plants and calculate selected quantities and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Ti	me in Lecture 70		
Credit points	6			
Examination	Writton oxom			



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



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



Course L0210: Gas and	Steam Power Plants
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Alfons Kather
Language	DF
Content	WiSe         In the 1 <sup>st</sup> part of the lecture a general introduction into fluid-flow machines and steam power plants i offered, including:         • Energy balance of a fluid-flow machine         • Theory of turbine and compressor stage         • Equal and positive pressure blading         • Flow losses         • Characteristic numbers         • Axial and radial design         • Design features         • Hydraulic fluid-flow machines         • Pump and water turbine designs         • Design examples of reciprocating engines and turbomachinery         • Steam power plants         • Gas turbine systems         • Diesel engine to the more specialised issues:         • Electricity Demand and Forecasting         • Thermodynamic fundamentals         • Energy Conversion in Thermal Power Plants
Literature	<ul> <li>grade.</li> <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, Kombikraftwerk Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland</li> </ul>

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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
-			_	_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, students	s have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>particular explain properties o</li> <li>They can explain the dynam terms of frequency response a</li> <li>They can explain the Nyquists</li> <li>They can explain the role of th</li> <li>They can explain the way a response</li> </ul>	mic system behavior in time and free f first and second order systems ics of simple control loops and inter ind root locus stability criterion and the stability marg e phase margin in analysis and synth PID controller affects a control loop ing when controllers designed in co	rpret dynam gins derived esis of contr p in terms o	ic properties i from it. rol 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 ar frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups i	to jointly solve technical problems, a	and experim	entally validat
Autonomy	Students can obtain information from provided sources (lecture notes, software documentati experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress			
Workload in Hours	Independent Study Time 124, Study T	ïme in Lecture 56		
Credit points				
-	Written exam			
Examination duration and scale				
	General Engineering Science (Germa General Engineering Science (Germa Compulsory General Engineering Science (Germa	nan program, 7 semester): Special	isation Con	

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



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

- 1	
	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
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 Not locus plots Strequency response techniques  Root locus adesign of PID controllers  Frequency response techniques  Root locus at a lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Similar predictor  Similar predictor  Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers  Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Courses				
Title		Тур	Hrs/wk	СР
Particle Technology I (L043		Lecture	2	3
Particle Technology I (L043 Particle Technology I (L044		Recitation Section (small) Practical Course	1 2	1 2
		Fractical Course	2	2
Module Responsible Admission	Prof. Stefan Heinrich			
Requirements	None			
Recommended Previous Knowledge	keine			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence		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>		I,
Skills	<ul> <li>Students are able to</li> <li>choose and design apparatuses and solids properties of the product</li> <li>asses solids with respect to their beh</li> <li>document their work scientifically.</li> </ul>		-	g to the desire
Personal Competence				
Social Competence	The students are able to discuss scientific to develop solutions for technical-scientific issues the state of the state o		or scientific	personal and
Autonomy	Students are able to analyze and solve que	stions regarding solid particles i	ndependen	tly.
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Workload in Hours Credit points		Lecture 70		
Credit points		Lecture 70		
Credit points	6 Written exam	Lecture 70		



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

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

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



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

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Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment	(L0860)	Lecture	2	2
Environmental Assessment	(L1054)	Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended	Fundamentals of inorganic/organic chemis	try and biology		
Previous Knowledge		a reached the following learning	reculto	
	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effective chains of potential environmental problems which might occur from production processes, projects construction measures. They have knowledge about the methodological diversity and are completed to the students acquire in the methodological diversity and are completed to the students acquire in the methodological diversity and are completed to the students acquire in the methodological diversity and are completed to the students acquire in the methodological diversity and are completed to the students acquire in the students acquire in the students acquire in the students acquired to the			
Skills	The students are able to select a suitable method for the respective case from the variety assessment methods. Thereby they can develop suitable solutions for managing and mitigatir environmental problems in a business context. They are able to carry out Life Cycle Impa 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 a multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical practical implementation. Due to the selected lecture topics, the students receive insights into t multi-layered issues of the environment protection and the concept of sustainability. Their sensitive and consciousness towards these subjects are raised and which helps to raise their awareness their future social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process ar carry out independent scientific work. They and are able to judge results of other public	v can solve an environmental pro	-	-
Workload in Hours	Independent Study Time 48, Study Time in	Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
	General Engineering Science (Germa Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German pro Elective Compulsory General Engineering Science (German pro Elective Compulsory Bioprocess Engineering: Core qualification Energy and Environmental Engineering: C	program): Specialisation Proc n program, 7 semester): Sp rogram, 7 semester): Specialisation ogram, 7 semester): Specialisation : Elective Compulsory	ess Engine pecialisation ation Proces	eering: Electi Energy a ss Engineerir
Assignment for the		and the second sec		

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Following Curricula	General Engineering Science (English program): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Elective
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Elective Compulsory
	Process Engineering: Core qualification: Elective Compulsory
	Process Engineering: Core qualification: Compulsory
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Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
Content	Contaminants: Impact- and Risk Assessment Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) Resource and water consumption: Material flow analysis Energy consumption: Cumulated energy demand (CED), cost analysis Life cycle concept: Life cycle assessment (LCA) Sustainability: Comprehensive product system assessment , SEE-Balance Management: Environmental and Sustainability management (EMAS) Complex systems: MCDA and scenario method	
Literature	Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)	



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



Module M0891: Inf	ormatics for Process Engine	eers		
Courses				
Title		Тур	Hrs/wk	СР
Informatics for Process Eng Informatics for Process Eng		Lecture Recitation Section (small)	2 2	2 2
Numeric and Matlab (L0125)		Practical Course	2	2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in using MS Windows	5.		
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
	Students can describe procedural and	object-oriented concepts.		
Knowledge				
Skills	Students are capable of object-oriented programming in the programing language Java and of solvi mathematic questions by using Matlab. Students are capable of developing concepts (simple algorithms) to solve technical questions.			
Personal Competence Social Competence	Students are able to work out solutions	together in small groups.		
Autonomy	Students are able to assess acquired s	kills by applying it in practice.		
Workload in Hours	Independent Study Time 96, Study Tim	e in Lecture 84		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (Gern Compulsory General Engineering Science (Ge Enviromental Engineering: Elective Co General Engineering Science (Germa Elective Compulsory Bioprocess Engineering: Core qualifica Energy and Environmental Engineering General Engineering Science (Engl Compulsory General Engineering Science (English Engineering: Elective Compulsory General Engineering Science (English Engineering: Elective Compulsory General Engineering Science (English Elective Compulsory Process Engineering: Core qualificatio	rman program, 7 semester): S mpulsory an program, 7 semester): Specialist ation: Compulsory g: Core qualification: Compulsory ish program): Specialisation Proc program, 7 semester): Specialisatio h program, 7 semester): Specialist	pecialisation ation Proces sess Engine on Energy ar	n Energy and ss Engineering eering: Elective nd Enviromenta



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



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

Course L0125: Numeric	and Matlab
Тур	Practical Course
Hrs/wk	2
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): <ol> <li>Moler, C., Numerical Computing with MATLAB, SIAM, 2004</li> <li>The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007</li> <li>Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de</li> <li>Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005</li> </ol>



Courses				
Title         Process and Plant Engineering I (L0095)         Process and Plant Engineering I (L0096)         Process and Plant Engineering I (L1214)		<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Georg Fieg			
Admission				
Recommended Previous Knowledge	unit operation of thermal an dmechanical s chemical reactor eingineering	eparation processes		
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence	students can:			
Knowledge	classify and formulate blobal balance equa specify linear component equations of com explain linear regression and data reconci explain pfd-diagrams	plex chemical processes		
Skills	students are capable of - formulation of mass and energy balance of - estimation of component streams of chem - solution of data reconcilliation tasks - conduction of process synthesis - economic evaluation of processes and the	nical plants using linear compone		
Personal Competence				
Social Competence				
Autonomy				
Credit points	Independent Study Time 124, Study Time i	n Lecture 56		
Examination				
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following Curricula	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (Germa Enviromental Engineering: Elective Compu Bioprocess Engineering: Core qualification General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory	ogram): Specialisation Bioproces rogram, 7 semester): Specialisation ogram, 7 semester): Specialisation n program, 7 semester): Sp ulsory n: Compulsory gram): Specialisation Bioprocess gram): Specialisation Process En rogram, 7 semester): Specialisation	s Engineeri ation Proces on Bioproce becialisation s Engineering ation Proces	ng: Compulso ss Engineerir ss Engineerir n Energy a ng: Compulso Compulsory ss Engineerir



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

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



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

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

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



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management Project Entrepreneurship (LC	. ,	<b>Typ</b> Lecture Project-/problem-based	Hrs/wk 3 2	<b>CP</b> 3 3
		Learning		
Module Responsible	Prof. Christoph Ihl			
Requirements	None			
Previous Knowledge	Basic Knowledge of Mathematics and Busi			
Educational Objectives	After taking part successfully, students have	e reached the following learning	ng results	
Professional Competence				
	<ul> <li>After taking this module, students know the Management, from Planning and Organis and Controlling. In particular they are able</li> <li>explain the differences between Management and to name importar</li> <li>explain the most important aspects aspects of entreprneurial projects</li> <li>describe and explain basic busin supply chain management, orgar management, innovation managem</li> <li>explain the relevance of planning multiple objectives and uncertain Finance</li> <li>state basics from accounting and comparison of the state basics from accounting accountin</li></ul>	ation to Marketing and Innov to Economics and Managemen at definitions from the field of M of and goals in Management ess functions as production nization and human ressour- tent and marketing and decision making in Busin ty, and explain some basic	ation, and als t and the su lanagement and name the , procuremen ce managem ness, esp. in s methods from	o to Investmen b-disciplines ir most importan t and sourcing ent, informatior situations unde
	Students are able to analyse business uni strategies etc.) and to carry out an Entrepre- analyse Management goals and str analyse organisational and staff str apply methods for decision making analyse production and procureme analyse and apply basic methods o select and apply basic methods fror apply basic methods from accountin	neurship project in a team. In ucture them appropriately uctures of companies under multiple objectives, unc nt systems and Business infor f marketing n mathematical finance to pre-	particular, the ler uncertainty mation system defined proble	y are able to and under risk s ems
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the l report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their f</li> </ul>	ecture to an entrepreneurship	project and v	write a coheren
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the</li> <li>to write a report on their project.</li> </ul>	eam themselves		
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points	6			
Evamination	Subject theoretical and practical work			
	,			



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

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



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



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



# **Specialization Computer Science**

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

Module M0561: Dis	screte Algebraic Structures			
Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structure	es (L0164)	Lecture	2	3
Discrete Algebraic Structure	es (L0165)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have re	ached 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	$_{e}$ 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 Time in L	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German progra General Engineering Science (German pro Compulsory Computer Science: Core qualification: Compu General Engineering Science (English progra General Engineering Science (English pro Compulsory Computational Science and Engineering: Cor Technomathematics: Specialisation I. Mathem	gram, 7 semester): Special Isory m): Specialisation Computer gram, 7 semester): Special e qualification: Compulsory	isation Con Science: Co	nputer Science



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

Course L0165: Discrete	ourse L0165: Discrete Algebraic Structures		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Karl-Heinz Zimmermann		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
A durie e ie u	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the Irks are lifted	examination's
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
	<ul> <li>This module deals with the foundations of the fur from the assembly-level programming down to gat</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean a combinational networks</li> <li>Sequential logic: Flip-flops, automata, syste</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subt</li> <li>Basics of computer architecture: Progr pipelining</li> <li>Memories: Memory hierarchies, SRAM, DF</li> <li>Input/output: I/O from the perspective of connections, busses</li> </ul> The students perceive computer systems from the structure and the physical composition of compute specific and individual computers can be built bat They are able to distinguish between and to computing systems - from gates and circuits up to a After successful completion of the module, the between a physical computer system and the understand the consequences that the execution layers from the assembly language down to gat impact that these low abstraction levels have o feasible options.	tes. The module includes algebra, Boolean funct ematic hardware design raction, multiplication and amming models, MIPS AAM, caches the CPU, principles of p architect's perspective, i ter systems. The studen used on a collection of fe explain the different ab complete processors. students are able to jun software executed on of software has on the h es. This way, they will b	the following ions, hardw d division single-cycle bassing data .e., they iden ts can analy w and simple ostraction lay dge the inte it. In particu ardware-cen be enabled t	g topics: are synthesis e architecture , point-to-poin tify the interna ze, how highly e components vers of today's rdependencies ilar, they shal tric abstraction o evaluate the
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly.
Autonomy	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration	90 minutes, contents of course and labs			

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

## TUHH

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

Course L0321: Compute	er Engineering	
Тур	Lecture	
Hrs/wk	5	
СР	4	
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Introduction</li> <li>Combinational Logic</li> <li>Sequential Logic</li> <li>Technological Foundations</li> <li>Representations of Numbers, Computer Arithmetics</li> <li>Foundations of Computer Architecture</li> <li>Memories</li> <li>Input/Output</li> </ul>	
Literature	<ul> <li>A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000.</li> <li>A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001.</li> <li>D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.</li> </ul>	

Course L0324: Computer Engineering	
Тур	Recitation Section (small)
Hrs/wk	1
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		Тур	Hrs/wk	СР
	y, Algorithms and Data Structures (L0131) y, Algorithms and Data Structures (L0132)	Lecture Recitation Section (small)	4 1	4 2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
Recommended	Lecture Prozedurale Programmierung or equivalent proficiency in imperative programming Mandatory prerequisite for this lecture is proficiency in imperative programming (C, Pascal, Fortran o similar). You should be familiar with simple data types (integer, double, char), arrays, if-then-else, for while, procedure calls or function calls, pointers, and you should have used all those in your owr programs and therefore should be proficient with editor, compiler, linker and debugger. In this lecture we will immediately start with the introduction of objects and we will not repeat the basics mentioned above. This remark is especially important for AIW, GES, LUM because those prerequisites are <b>not</b> part of the curriculum. They are prerequisites for the start of those curricula in general. The programs ET, CI and IIW include those prerequisites in the first semester in the lecture Prozedurale Programmierung.			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Students can describe fundamental data structures of discrete mathematics and assess the comple of important algorithms for sorting and searching.			s the complex
Skills	<ul> <li>Students are able to</li> <li>Design software using given design patterns and applying class hierarchies and polymorphisr</li> <li>Carry out software development and tests using version management systems and Google Test</li> <li>Sort and search for data efficiently</li> <li>Assess the complexity of algorithms.</li> </ul>			
Personal Competence Social Competence	Students can work in teams and communica	ate in forums.		
	Students are able to solve programming tasks such as LZW data compression using SVN Repositor and Google Test independently and over a period of two to three weeks.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
Examination				
Examination duration	60 Minutes, Content of Lecture, exercises a	nd material in StudIP		



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

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

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



ourses				
ītle		Тур	Hrs/wk	СР
Signals and Systems (L0432	2)	Lecture	3	4
Signals and Systems (L0433	3)	Recitation Section (large)	1	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths a covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation (Fourier series, Fourier transform, Laplace transform) is useful but not required.			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	g results	
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist			
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 regarding important properties such as magnitude and phase response, stability, linearity etc They can asset the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
Social Competence	The students can jointly solve specific pro	blems.		
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system.			
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			
	General Engineering Science (German p General Engineering Science (German p General Engineering Science (German p	rogram): Specialisation Process	Engineering: ss Engineeri	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 Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



urse L0432: Signals a	nd Systems		
Тур	Lecture		
Hrs/wk	3		
СР			
	Independent Study Time 78, Study Time in Lecture 42		
	Prof. Gerhard Bauch		
Language			
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. Teubne Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>		



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



	-		-						
Courses									
<b>Title</b> Graph Theory and Optimiza Graph Theory and Optimiza						<b>Typ</b> Lecture Recitation Section (sn	nall)	<b>Hrs/wk</b> 2 2	СР 3 3
Module Responsible	Prof. A	Anusch Tara	az						
Admission Requirements	None								
Recommended Previous Knowledge		Discrete A Mathemat	-	tructures					
Educational Objectives	After ta	aking part s	uccessfully	y, students	have reach	ed the following lear	ning	results	
Professional Competence									
Knowledge	•	explain the Students illustrating	em using a can discu g these con	appropriate Iss logical Inections v	e examples. connection	Graph Theory and s between these co of examples. luce them.			-
Skills		studied in methods. Students studied in For a give	a this cours are able t the course	to discover to discover e. , the stude	ver, they an r and verify ents can dev	eory and Optimization e capable of solving further logical conn elop and execute a	g thei nectio	m by apply	ng establishe
Personal Competence									
Social Competence	•	common l In doing s	anguage. so, they car	n commun	icate new c	ams. They are cap oncepts according to ples to check and de	o the	needs of th	eir cooperatin
Autonomy		can specit Students I	fy open que	estions pre loped suffi	ecisely and l cient persist	derstanding of comp know where to get he ence to be able to w	elp in	solving the	n.
Workload in Hours	Indepe	endent Stud	dy Time 124	4, Study Ti	ime in Lectu	re 56			
Credit points	6								
Examination	Writter	n exam							
Examination duration and scale	120 m	iin							
Assignment for the	Gener Comp Comp	ral Enginee ulsory uter Scienc	ering Scier	nce (Germ	nan program Compulsor	Specialisation Comp n, 7 semester): Spe y Specialisation Comp	eciali	sation Corr	puter Science



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

 Computational Science and Engineering: Core qualification: Compulsory

 Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

 Technomathematics: Specialisation I. Mathematics: Elective Compulsory

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



Module M0727: Sto	ochastics			
Courses				
<b>Title</b> Stochastics (L0777) Stochastics (L0778)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Calculus</li> <li>Discrete algebraic structures (combinatorio</li> <li>Propositional logic</li> </ul>	cs)		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students can explain the main definitions of p modeling elements (random variables, events, discrete and continuous settings (joint and marg describe characteristic notions such as expected Students can define decision problems and expla the chain rule or Bayesian networks). Algorithms, terms of notions such as bias of an estimator, etc processes and explain algorithms for solving processes. Students can also explain basic statistic Students can apply algorithms for solving du	dependence, independer ginal distributions, densit values, variance, standar ain algorithms for solving or estimators as they are c. Student can describe th decision and computation ical detection and estimation	nce assump y functions). d deviation, these proble caller, can l the main idea on problem on technique	tions) used in Students can and moments ems (based on be analyzed in as of stochastic for stochastic es.
Skills	approximation techniques are good enough in va estimators and judge whether they are applicable	arious application context	is, i.e., stude	ents can derive
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their teams (i.e., teams from different study programs results appropriately (e.g. during exercise class).	•	•	•
	- Students are capable of checking their understa specify open questions precisely and know where			own. They car
Autonomy	- Students can put their knowledge in relation to th	e contents of other lecture	es.	
	- Students have developed sufficient persistenc oriented manner on hard problems.	e to be able to work for	longer perio	ods in a goal·
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program): General Engineering Science (German program Compulsory Computer Science: Core qualification: Compulsor General Engineering Science (English program): General Engineering Science (English program Compulsory Computational Science and Engineering: Core qua	n, 7 semester): Specialis y Specialisation Computer S n, 7 semester): Specialis	sation Comp Science: Cor	puter Science



ourse L0777: Stochast	ics
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Francisco Javier Hoecker-Escuti
Language	EN
Cycle	SoSe
	Foundations of probability theory
	<ul> <li>Definitions of probability, conditional probability</li> <li>Random variables, dependencies, independence assumptions,</li> <li>Marginal and joint probabilities</li> <li>Distributions and density functions</li> <li>Characteristics: expected values, variance, standard deviation, moments</li> </ul>
Content	<ul> <li>Practical representations for joint probabilities</li> <li>Bayessche Netzwerke</li> <li>Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen</li> <li>Stochastic processes</li> </ul>
	<ul> <li>Stationarity, ergodicity</li> <li>Correlations</li> <li>Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues</li> </ul> Detection & estimation
	<ul> <li>Detectors</li> <li>Estimation rules and procedures</li> <li>Hypothesis and distribution tests</li> <li>Stochastic regression</li> </ul>
Literature	<ol> <li>Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008</li> <li>Stochastik für Informatiker, Dümbgen, L., Springer 2003</li> <li>Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 20</li> <li>Stochastik, Georgii, HO., deGruyter, 2009</li> <li>Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2007</li> <li>Programmieren mit R, Ligges, U., Springer 2008</li> </ol>

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



Courses				
Title		Тур	Hrs/wk	СР
Automata Theory and Forma	al Languages (L0332)	Lecture	2	4
Automata Theory and Forma	al Languages (L0507)	Recitation Section (small	2	2
Module Responsible	Prof. Tobias Knopp			
Admission Requirements	None			
	Participating students should be able	e to		
	- specify algorithms for simple data s	tructures (such as, e.g., arrays) to sol	ve computatio	onal problems
Recommended Previous Knowledge		cate logic for specifying and understa	-	-
	- apply the knowledge and skills tau	ht in the module Discrete Algebraic	Structures	
Educational Objectives	After taking part successfully, studen	ts have reached the following learnir	g results	
Professional			5	
Competence				
Knowledge	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			
Skills	Students can apply propositional log Students analyze application prob temporal logic formulas to represer particular application problem, and problems to specific formulas. S deterministic ones, or derive gramm work, and they can apply algorithms	ems in order to derive proposition at them. They can evaluate which for they can demonstrate the applicati students can also transform non mars from automata and vice versa.	al logic, pre prmalism is b on of algorith deterministic They can sho	dicate logic, est suited for ms for decision automata in pw how parse
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
	Written exam			
Examination duration and scale	90 min			
Assignment for the	General Engineering Science (Germ General Engineering Science (Ger Elective Compulsory Computer Science: Core qualificatio	man program, 7 semester): Speci		



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

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

 Elective Compulsory

 Computational Science and Engineering: Core qualification: Compulsory

 Technomathematics: Specialisation II. Informatics: Elective Compulsory

<b>T</b>	Lastura
	Lecture
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Tobias Knopp
Language	
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: 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: Correctness of the minimization procedure, equivalence classes of strings induced automata</li> <li>Pumping Lemma for regular languages: provision of a tool which, in some cases, can be used to show that a finite automat principally cannot be expressive enough to solve a word problem for some given language</li> <li>Regular expressions vs. finite automata: Equivalence of formalisms, systematic transformation of representations, reductions</li> <li>Pushdown automata, definition of context-free grammars. Definition of pushdown automata, definition of context-free grammars, derivations, parse tre ambiguities, pumping lemma for context-free grammars, transformation of formalisms (fr pushdown automata do context-free grammars and back)</li> <li>Chrk algorithm for deciding the word problem for context-free grammrs</li> <li>Deterministic pushdown automata</li> <li>CYK algorithm for deciding the word problem for context-free grammars</li> <li>Deterministic vs. nondeterministic pushdown automata: Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdo automata, compiler</li> <li>Regular grammars</li> <li>Chomsky hierarchy</li> <li>Mealy- and Moore automata: Automata with output (w/o accepting states), infinite state sequences, automata networks</li> <li>Omega automata: Automata for infinite input words, Büchi auto</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	urse L0507: Automata Theory and Formal Languages		
Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Tobias Knopp		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Module M0803: En	nbedded Systems			
Courses				
Title Embedded Systems (L0805 Embedded Systems (L0806		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Computer Engineering			
Educational Objectives	After taking part successfully, students have re-	ached the following learning	results	
Professional Competence				
	Embedded systems can be defined as infor products. This course teaches the foundation introduction into these systems (notions, com (models of computation, hierarchical automa specification of real-time applications, translation	ons of such systems. In p imon characteristics) and the ata, specification of distribu	articular, it eir specifica ted system	deals with an ation languages
Knowledge	Another part covers the hardware of embedded systems: Sonsors, A/D and D/A converters, real-time capable communication hardware, embedded processors, memories, energy dissipation reconfigurable logic and actuators. The course also features an introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedded system using hardware/software co-design (hardware/software partitioning, high-level transformations of specifications, energy-efficient realizations, compilers for embedded processors) is covered.			
Skills	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize which relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall be able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge in which areas of embedded system design specific risks exist.			
Personal Competence				
Social Competence	Students are able to solve similar problems alo	one or in a group and to pres	ent the resu	Its accordingly.
Autonomy	Students are able to acquire new knowledge with other classes.	from specific literature and t	o associate	this knowledge
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
Assignment for the Following Curricula				



Course L0805: Embedde	ed Systems
Тур	Lecture
Hrs/wk	3
CP	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: Embedde	Irse L0806: Embedded Systems		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



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

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



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

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



Module M0834: Co	omputernetworks and Intern	et Security		
Courses				
Title Computer Networks and Int Computer Networks and Int		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 5 1
Module Responsible Admission Requirements	Prof. Andreas Timm-Giel None			
	Basics of Computer Science			
Educational Objectives Professional Competence				
Knowledge	Students are able to explain important and common Internet protocols in detail and classify them, in 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 differen domains.			hem in different
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts independently learn and understand		onal knowl	edge and can
Workload in Hours	Independent Study Time 124, Study T	ïme in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			



Course L1098: Compute	r 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>

Course L1099: Computer Networks and Internet Security			
Тур	Typ Recitation Section (small)		
Hrs/wk	1		
CP	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: Fu	nctional Programming			
Courses				
Title Functional Programming (L0624) Functional Programming (L0625) Functional Programming (L0626)		<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous Knowledge	Discrete mathematics at high-school level			
Educational Objectives	After taking part successfully, students have rea	ched 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 Lect	ure 84		
Credit points	6			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			



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

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



Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Sibylle Schupp
Language	
Cycle	
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: Nu	merical Mathematics I			
0				
Courses Title Numerical Mathematics I (L0 Numerical Mathematics I (L0		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
	Prof. Sabine Le Borne			
Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Studer II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	nts (german or english) <b>or</b> Ai	nalysis & Lir	near Algebra I
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students are able to</li> <li>name numerical methods for interpolation, integration, least squares problems, eigenvalu problems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computationa and storage complexitx.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numeric</li> <li>justify the convergence behaviour of solution algorithm,</li> <li>select and execute a suitable solution a</li> </ul>	numerical methods with re		e problem an
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work together in heterogeneously compand background knowledge), explain practical aspects regarding the implement</li> </ul>	theoretical foundations an		
Autonomy	Students are capable			
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program General Engineering Science (German prog Biomechanics: Compulsory General Engineering Science (German prog Materials in Engineering Sciences: Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Com	gram): Specialisation Mech gram): Specialisation Mech y m): Specialisation Biomedica ram, 7 semester): Specialisation m, 7 semester): Specialisation	anical Engi anical Engi al Engineeri isation Con	neering, Focu neering, Focu ng: Compulsor nputer Science



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

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



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



Module M0791: Co	omputer Architecture			
Courses				
Title		Тур	Hrs/wk	СР
Computer Architecture (L07	93)	Lecture	2	3
Computer Architecture (L07	94)	Project-/problem-based Learning	2	2
Computer Architecture (L18	64)	Recitation Section (small)	1	1
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Computer Engineering"			
Educational Objectives	After taking part successfully, students have reach	ned 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 architectura principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g. performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-leve parallelism.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly		Its accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and 4 attestations from the PBL "Computer architecture"			
Assignment for the Following Curricula				



Course L0793: Compute	r Architecture		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Heiko Falk		
Language	DE/EN		
Cycle	WiSe		
	<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>		

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

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



Courses				
Title Introduction to Control Syste	. ,	<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
-			_	_
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, studen	ts 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 i terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain ar implemented digitally</li> </ul>			
Skills	<ul> <li>vice versa</li> <li>They can simulate and asses</li> <li>They can design PID controll</li> <li>They can analyze and syr frequency response techniqu</li> <li>They can calculate discrete and use it for digital impleme</li> </ul>	-time approximations of controllers de	oops ichols) tunin ne help of esigned in o	ng rules root locus an continuous-tim
Personal Competence				
Social Competence		to jointly solve technical problems, a	and experim	entally validat
Autonomy	their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
-	Written exam			
Examination duration and scale				
		nan program): Core qualification: Comp rman program, 7 semester): Special	isation Con	

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

I	Typ Lecture			
Hrs/wk				
CP				
	ndependent Study Time 92, Study Time in Lecture 28 rof. Herbert Werner			
Language				
Cycle	Signals and systems			
	<ul> <li>Linear systems, differential equations and transfer functions</li> <li>First and second order systems, poles and zeros, impulse and step response</li> <li>Stability</li> </ul>			
	<ul> <li>Feedback systems</li> <li>Principle of feedback, open-loop versus closed-loop control</li> <li>Reference tracking and disturbance rejection</li> </ul>			
	<ul> <li>Types of feedback, PID control</li> <li>System type and steady-state error, error constants</li> <li>Internal model principle</li> </ul>			
	<ul> <li>Root locus techniques</li> <li>Root locus plots</li> <li>Root locus design of PID controllers</li> </ul>			
Content	<ul> <li>Frequency response techniques</li> <li>Bode diagram</li> <li>Minimum and non-minimum phase systems</li> <li>Nyquist plot, Nyquist stability criterion, phase and gain margin</li> <li>Loop shaping, lead lag compensation</li> <li>Frequency response interpretation of PID control</li> </ul>			
	<ul> <li>Time delay systems</li> <li>Root locus and frequency response of time delay systems</li> <li>Smith predictor</li> </ul>			
	<ul> <li>Digital control</li> <li>Sampled-data systems, difference equations</li> <li>Tustin approximation, digital implementation of PID controllers</li> </ul>			
	<ul> <li>Software tools</li> <li>Introduction to Matlab, Simulink, Control toolbox</li> <li>Computer-based exercises throughout the course</li> </ul>			
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, 1 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 M0562: Co	omputability and Complexity Theory	,		
Courses				
Title		Тур	Hrs/wk	СР
Computability and Complexi	ty Theory (L0166)	Lecture	2	3
Computability and Complexi	ty Theory (L0167)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Discrete Algebraic Structures, Automata Theory	Logic, and Formal Langua	ge Theory.	
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence				
Knowledge	The students known the important machine models of computability, the class of partial recursive functions, universal computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable and undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence systems, Hilbert's 10-th problem, and the basic concepts of complexity theory.			
Skills	Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions.			
Personal Competence				
Social Competence	Chidante exe elle te celle anosific probleme elene er in e group and te procent the results coordinal.			
Autonomy	Students are able to acquire new knowledge from newer literature and to associate the acquirec knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Examination				
Examination duration and scale	20 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 Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory			

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



Course L0167: Computa	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: So	ftware Engineering			
Courses				
<b>Title</b> Software Engineering (L062 Software Engineering (L062)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Sibylle Schupp			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Automata theory and formal languages</li> <li>Procedural programming or Functional p</li> <li>Object-oriented programming, algorithms</li> </ul>			
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	Students explain the phases of the software life cycle, describe the fundamental terminology and concepts of software engineering, and paraphrase the principles of structured software development. They give examples of software-engineering tasks of existing large-scale systems. They write tes 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 ar 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				
	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 Lec	ture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
	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 Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			



Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	SoSe
Content	<ul> <li>Software Life Cycle Models (Waterfall, V-Model, Evolutionary Models, IncrementalModel: Iterative Models, Agile Processes)</li> <li>Requirements (Elicitation Techniques, UML Use Case Diagrams, Functional and Nor Functional Requirements)</li> <li>Specification (Finite State Machines, Extended FSMs, Petri Nets, Behavioral UML Diagram: Data Modeling)</li> <li>Design (Design Concepts, Modules, (Agile) Design Principles)</li> <li>Object-Oriented Analysis and Design (Object Identification, UML Interaction Diagrams, UM Class Diagrams, Architectural Patterns)</li> <li>Testing (Blackbox Testing, Whitebox Testing, Control-Flow Testing, Data-Flow Testing, Testin 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	Course 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		



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management (L0880) Project Entrepreneurship (L0882)		<b>Typ</b> Lecture Project-/problem-based	Hrs/wk 3 2	<b>СР</b> 3 3
		Learning		
Module Responsible	Prof. Christoph Ihl			
Requirements	None			
Previous Knowledge	Basic Knowledge of Mathematics and Busi			
Educational Objectives	After taking part successfully, students have	e reached the following learnir	ng results	
Professional Competence				
	<ul> <li>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</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>			
	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</li> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods for marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>			
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</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the</li> <li>to write a report on their project.</li> </ul>	team themselves		
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points	6			
<b>E</b> wa main atia n	Subject theoretical and practical work			
Examination				



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

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



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



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



Module M1269: La	b Cyber-Physical Systems			
Coursee				
Courses Title		Tun	Hrs/wk	СР
Lab Cyber-Physical System	s (L1740)	<b>Typ</b> Project-/problem-based Learning	4	6
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Embedded Systems"			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence	Cyber-Physical Systems (CPS) are tightly inte A/D and D/A converters, and actors. Due to	-		
Knowledge	A/D and D/A converters, and actors. Due to their particular application areas, highly specialized sensors, processors and actors are common. Accordingly, there is a large variety of different specification approaches for CPS - in contrast to classical software engineering approaches. Based on practical experiments using robot kits and computers, the basics of specification and modelling of CPS are taught. The lab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of computation, hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the lab's experiments will base on simple control applications. The experiments will use state-of-the-ar industrial specification tools (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and actors.			
Skills	After successful attendance of the lab, students are able to develop simple CPS. They understand the interdependencies between a CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D converters, digital processors, D/A converters and actors. The lab enables students to compare modelling approaches, to evaluate their advantages and limitations, and to decide which technique to use for a concrete task. They will be able to apply these techniques to practical problems. They obtain first experiences in hardware-related software development, in industry-relevant specification tools and in the area of simple control applications.			
Personal Competence				
Social Competence	Students are able to solve similar problems alo	one or in a group and to pres	ent the resu	Its 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 Le	ecture 56		
Credit points				
	Written elaboration			
Examination duration and scale	Execution and documentation of all lab experi	ments		



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



Module M0971: Op	erating Systems			
Courses				
Title	т	ур	Hrs/wk	СР
Operating Systems (L1153)	-	ecture	2	3
Operating Systems (L1154)	Re	ecitation Section (small)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Object-oriented programming, algorithms, and</li> <li>Procedural programming</li> <li>Experience in using tools related to operating</li> <li>Experience in using C-libraries</li> </ul>		rs, linkers, c	compilers
Educational Objectives	After taking part successfully, students have reached	the following learning r	results	
Professional Competence				
Knowledge	Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file or operations systems, describe the process states and their transitions, and paraphrase the architectura 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 giver environment.			
Personal Competence				
Social Competence				
Autonomy				
· · · · · · · · · · · · · · · · · · ·	Independent Study Time 124, Study Time in Lecture	56		
Credit points				
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): Sp General Engineering Science (German program, Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Sp General Engineering Science (English program, Elective Compulsory Computational Science and Engineering: Specialisat Computational Science and Engineering: Specialisat Technomathematics: Specialisation II. Informatics: Election	7 semester): Specialis ecialisation Computer S 7 semester): Specialis tion Computer Sciences tion Computer Sciences	sation Com Science: Co sation Com	mputer Science mpulsory aputer Science ompulsory



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

Course L1154: Operating	ourse L1154: Operating Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Volker Turau	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Courses				
Title Mathematical Statistics (L13: Mathematical Statistics (L13:		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
	Prof. Natalie Neumeyer		•	-
Admission				
Requirements	None			
Provious Knowledge	Mathematical Stochastics Measure Theory and Stochastics			
	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
Knowledge	<ul> <li>Students can describe basic concernent Maximum-Likelihood methods for optimal tests for parametric proba application to estimation and test domains and test families. They are</li> <li>Students can discuss logical con illustrating these connections with t</li> <li>They know proof strategies and can</li> </ul>	construction of estimators, opt bility distributions, sufficiency a st problems, tests in normal c able to explain them using app nections between these conce the help of examples.	imal unfalsi nd complete listribution a ropriate exa	fied estimato eness and the and confiden mples.
Skills	<ul> <li>Students can model problems in M in this course. Moreover, they are constructed by Students are able to discover an studied in the course.</li> <li>For a given problem, the students of to critically evaluate the results.</li> </ul>	apable of solving them by applyi d verify further logical connecti	ng establish ons betwee	ed methods. n the concep
Personal Competence				
Social Competence	<ul> <li>Students are able to work togeth common language.</li> <li>In doing so, they can communicate partners. Moreover, they can desig peers.</li> </ul>	e new concepts according to the	needs of th	ieir cooperatii
Autonomy	<ul> <li>Students are capable of checking to can specify open questions precise</li> <li>Students have developed sufficien oriented manner on hard problems</li> </ul>	ely and know where to get help in t persistence to be able to work	solving the	m.
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 minutes			



Assignment for the Following Curricula Elective Computer Science: Specialisation Computational Mathematics: Elective Compulsory Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory

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

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



## **Specialization Mechanical Engineering**

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

Graduates have:

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

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

3) In-depth knowledge in Engineering applications, especially in the selected subject area of 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

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

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



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



Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	<ul> <li>Basics of 3D CAD technology</li> <li>Practical course to apply a 3D CAD system         <ul> <li>Introduction to the system</li> <li>Sketching and creation of components</li> <li>Creation of assemblies</li> <li>Deriving technical drawings</li> </ul> </li> </ul>
Literature	<ul> <li>CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, 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.); Springe 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, aktuell Auflage.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



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

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



Course L0267: Team Pro	oject Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	<ul> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>



Module M0933: Fu	ndamentals of Materials Science			
-				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S		Lecture	2	2
Fundamentals of Materials Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	tics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and ca describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion ar mechanical properties. The students know about the key aspects of characterization methods f materials and can identify relevant approaches for characterizing specific properties. They are able trace materials phenomena back to the underlying physical and chemical laws of nature.			
Skills	The students are able to trace materials phenom laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosid solidification, precipitation, or melting. The stud conditions and the materials microstructure, and t the material's behavior.	to mechanical properties on resistance, and to pha ents can explain the rel	such as stre se transform ation betwe	ength, ductilit ations such a en processin
Personal Competence				
Social Competence				
Autonomy				
-	Independent Study Time 96, Study Time in Lecture	<b>₩</b>		
Credit points		; 04		
	Written exam			
Examination duration				
and scale	180 min			
	General Engineering Science (German prog	ram): Specialisation E	nergy and	Enviroment
	Engineering: Compulsory			
	General Engineering Science (German pro	gram): Specialisation	Mechanical	Engineerin
	Compulsory General Engineering Science (German program):	Specialization Biomedica	l Engineerin	a: Compulso
	General Engineering Science (German program): General Engineering Science (German program, 7	Specialisation Naval Arch	nitecture: Co	mpulsory
	Compulsory General Engineering Science (German program, 7 Compulsory	7 semester): Specialisatio	on Biomedica	al Engineering
	General Engineering Science (German progran Compulsory			
	General Engineering Science (German prog Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qua		ecialisation	Energy an
	[22.4]			



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

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

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



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



Courses			
Title	Тур	Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)	Lecture Recitation Section (large)	3 2	4 2
Module Responsible	Prof. Thomas Rung		
Admission Requirements	None		
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechanics and	d thermodyr	amics.
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional Competence			
Knowledge	Students will have the required sound knowledge to explain the general prin and physics of fluids. Students can scientifically outline the rational mathematical models and are familiar with methods for the performance an fluid engineering devices.	le of flow	physics usir
Skills	Students are able to apply fluid-engineering principles and flow-physics technical systems. The lecture enables the student to carry out all necessar for the fluid dynamic design of engineering devices on a scientific level.	models for ary theoreti	the analysis cal calculation
Personal Competence			
Social Competence	The students are able to discuss problems and jointly develop solution strate	egies.	
Autonomy	The students are able to develop solution strategies for complex problems analyse results.	self-consist	ent and crtica
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points			
Examination	Written exam		
Examination duration and scale	180 min		
	General Engineering Science (German program): Specialisation Compulsory General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Naval Arch General Engineering Science (German program, 7 semester): Specialisatio Compulsory General Engineering Science (German program, 7 semester): Specialisatio Compulsory General Engineering Science (German program, 7 semester): Specialisatio	al Engineerii hitecture: Co n Mechanic on Biomedic	ng: Compulso ompulsory al Engineerir al Engineerir



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

Course L0454: Fluid Med	chanics
Тур	Lecture
Hrs/wk	3
CP	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 Med	ourse L0455: Fluid Mechanics	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0960: N Systems)	lechanics IV (Kinetics II, Oscillations, Analytical Mechanics,	Multibody
oystems)		
Courses		
Title	Typ Hrs/wk	СР
(L1137)	Oscillations, Analytical Mechanics, Multibody Systems) Lecture 3	3
(L1130)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small) 2	2
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large) 1	1
Module Responsible		
Admission Requirements	None	
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional		
Competence	The students con	
Knowledge	<ul> <li>The students can</li> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>	
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and m 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 app problem sets.</li> </ul>	
Personal Competence		
Social Competence	The students can work in groups and support each other to overcome difficulties.	
	Students are capable of determining their own strengths and weaknesses and to orga and learning based on those.	anize their tim
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	
Credit points		
-	Written exam	
Examination duration and scale	120 min	
	General Engineering Science (German program): Specialisation Mechanical Compulsory General Engineering Science (German program): Specialisation Biomedical Engineerir	-
	General Engineering Science (German program): Specialisation Naval Architecture: Co General Engineering Science (German program, 7 semester): Specialisation Mechanic Compulsory	mpulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedic Compulsory	-
	General Engineering Science (German program, 7 semester): Specialisation Nava Compulsory	
Assignment for the Following Curricula		g: Compulsor mpulsory
C C		



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

Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> </ul>
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009) D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011) W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

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



ourse 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 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				
Admission	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ectrical engineering		
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
	Students are able to name the most imp (Quantities and Units, Uncertainty, Calibrati Systems).			
Knowledge	They can outline the most important meas maesured (Electrical Quantities, Temperature,	-		
	They can describe important methods of Chromatography)	chemical Analysis (Gas Se	ensors, Spe	ctroscopy, G
Skills	Students can select suitable measuring measurement devices in practice. The students are able to orally explain issue solution approaches as well as place the issue	es in the subject area of me	asurement	technology a
Personal Competence	Students can arrive at work results in groups a	and document them in a comr	non report.	
Social Competence				
	Students are able to familiarize themselves wi		ogies.	
	Independent Study Time 110, Study Time in Lo	ecture 70		
Credit points Examination				
Examination duration and scale	105 minutes			
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Enviromental Engineering: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra	program): Specialisation am): Specialisation Biomedica am): Specialisation Process E program, 7 semester): Sp am, 7 semester): Specialisatio am, 7 semester): Specialisatio	Mechanica al Engineeri ingineering: becialisatior on Mechanic on Biomedic	I Engineerir ng: Compulsor Compulsory Energy a al Engineerir cal Engineerir
	General Engineering Science (German prog Compulsory Energy and Environmental Engineering: Core			



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



Course L1119: Practical	Course: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
CP	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
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 BI.1, 2451 BI.4, 2453 BI.5, 2455 BI.1</li> </ul>
Literature	<ul> <li>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> </ul>
	<ul> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> <li>Versuch 4: <ul> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul> </li> </ul>



ourse L1116: Measure	ment Technology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Cycle	
	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
Content	2.6 Data Transmission
Content	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 97 3486217940.



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

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Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L0925) Quality Management (L0926)		Lecture Lecture	2	3 3
		Lecture	2	5
Admission Requirements	Prof. Hermann Lödding None			
Recommended Previous Knowledge	None			
<b>Educational Objectives</b>	After taking part successfully, s	tudents have reached the following	learning results	
Professional Competence				
Knowledge	Students are able to explain the contents of the lecture of the module.			
Skills	Students are able to apply the methods and models in the module to industrial problems.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Study Time 124, Study Time 124, Study Study Time 124, Study St	Study Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 Minuten			
Assignment for the Following Curricula	Compulsory General Engineering Science ( Elective Compulsory General Engineering Science Compulsory General Engineering Science Elective Compulsory Logistics and Mobility: Speciali	(German program): Specialisation (German program, 7 semester): Spe (English program): Specialisation (English program, 7 semester): Specialisation sation Engineering Science: Elective qualification: Elective Compulsory	cialisation Mechanic Mechanical Engin cialisation Mechanic	cal Engineerir eering: Electi



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

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



Courses				
Fitle		Тур	Hrs/wk	СР
Electrical Machines (L0293)		Lecture	3	4
Electrical Machines (L0294)		Recitation Section (large)	2	2
Module Responsible	Prof. Thanh Trung Do			
Admission				
Requirements	None			
Basics of mathematics, in particular complexe numbers, integrals, differentials Recommended				
	Basics of electrical engineering and mech	nanical engineering		
-	After taking part successfully, students hav	ve reached the following learning	results	
Professional Competence				
Compotence	I Students can to draw and explain the bas	sic principles of electric and magn	etic fields.	
Knowledge	They can describe the function of th corresponding equations and characteri			
_	major parameters of the energy efficien	cy of the whole system from the	e power grid	d to the driv
	engine.			
	Students arw able to calculate two-dimens	sional electric and magnetic fields	s in particula	r ferromagne
	circuits with air gap. For this they apply the	e usual methods of the design auf	electric mac	hines.
	They can calulate the operational perform	nance of electric machines from th	eir given cha	aracteristic d
Skills	and selected quantities and characteris			
	graphical methods.			
Deve and Commetence				
Personal Competence				
Social Compotence	nono			
Social Competence	1	ulata alaatria and magnatia fialde	for oppligat	tions Thou
Social Competence	Students are able independently to calcu			
	1	onal performance of electric mach	nines from th	
	Students are able independently to calculate able to analyse independently the operation	onal performance of electric mach	nines from th	
	Students are able independently to calculate able to analyse independently the operation	onal performance of electric mach	nines from th	
Autonomy Workload in Hours	Students are able independently to calcuable to analyse independently the operation data and theycan calculate thereof selected Independent Study Time 110, Study Time	onal performance of electric mached quantities and characteristic cu	nines from th	
Autonomy Workload in Hours Credit points	Students are able independently to calcuable to analyse independently the operatidata and theycan calculate thereof selecters Independent Study Time 110, Study Time 6	onal performance of electric mached quantities and characteristic cu	nines from th	
Autonomy Workload in Hours Credit points Examination	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6	onal performance of electric mached quantities and characteristic cu	nines from th	
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6	onal performance of electric mached quantities and characteristic cu	nines from th	
Autonomy Workload in Hours Credit points Examination	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam	onal performance of electric mached quantities and characteristic cu in Lecture 70	nines from th	e characters
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6	onal performance of electric mached quantities and characteristic cu in Lecture 70	nines from th	e characters
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering Science (German Engineering Science (German	onal performance of electric mached quantities and characteristic cu in Lecture 70 an program): Specialisation E	nines from th irves.	e characters
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering Science (German Compulsory General Engineering Science (German Compulsory	onal performance of electric mached ad quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha	nines from th Irves.	Enviromer
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering Science (German Compulsory General Engineering Science (German Compulsor) Science	onal performance of electric mached ad quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha	nines from th Irves.	Enviromer
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (German Compulsory	onal performance of electric mached ad quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp	nines from th irves.	e characters Enviromer eering: Elect Energy a
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected data and they calculate thereof selected data and the thereof selected data and they calculate thereof selected data and the t	onal performance of electric mached ad quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Specialisation	nines from th irves.	e characters Enviromer eering: Elect Energy a
Autonomy Workload in Hours Credit points Examination Examination duration	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected data and they calculate thereof selected data and the thereof selected data and they calculate thereof selected data and the t	onal performance of electric mache ed quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp rogram, 7 semester): Specialisatio	nines from th irves.	e characters Enviromer eering: Elect Energy a
Autonomy Workload in Hours Credit points Examination Examination duration and scale	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected data and the thereof selected data and theycan calculate thereof selec	onal performance of electric mache ed quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp rogram, 7 semester): Specialisatio Elective Compulsory Core qualification: Compulsory	nines from th irves.	e characters Enviromer eering: Elect Energy a al Engineeri
Autonomy Workload in Hours Credit points Examination Examination duration and scale	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory Elective Compulsory Electrical Engineering: Core qualification: Energy and Environmental Engineering: Core General Engineering Science (Englise	onal performance of electric mache ed quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp rogram, 7 semester): Specialisatio Elective Compulsory Core qualification: Compulsory	nines from th irves.	e characters Enviromer eering: Elect Energy a al Engineeri
Autonomy Workload in Hours Credit points Examination Examination duration and scale	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Elective Compulsory Electrical Engineering: Core qualification: Energy and Environmental Engineering: C General Engineering Science (Englise Engineering: Compulsory General Engineering Science (Englise	onal performance of electric mached ad quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp rogram, 7 semester): Specialisation : Elective Compulsory Core qualification: Compulsory sh program): Specialisation E	nines from the inves.	e characters Enviromer eering: Elect Energy a al Engineeri Enviromer
Autonomy Workload in Hours Credit points Examination Examination duration and scale	Students are able independently to calca able to analyse independently the operati data and theycan calculate thereof selected Independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory Electrical Engineering: Core qualification: Energy and Environmental Engineering: C General Engineering Science (Englise Engineering: Compulsory General Engineering Science (Englise Engineering: Compulsory General Engineering Science (Englise Engineering: Compulsory	onal performance of electric mach ed quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp rogram, 7 semester): Specialisation Elective Compulsory Core qualification: Compulsory sh program): Specialisation E program): Specialisation E	nines from the inves.	e characters Enviromen eering: Elect Energy a al Engineeri Enviromen eering: Elect
Autonomy Workload in Hours Credit points Examination Examination duration and scale	Students are able independently to calculate to analyse independently the operation data and theycan calculate thereof selected independent Study Time 110, Study Time 6 Written exam 120 Minuten General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German Elective Compulsory Electrical Engineering: Core qualification: Energy and Environmental Engineering: C General Engineering Science (Englise Engineering: Compulsory General Engineering Science (Englise	onal performance of electric mach ed quantities and characteristic cu in Lecture 70 an program): Specialisation E program): Specialisation Mecha an program, 7 semester): Sp rogram, 7 semester): Specialisation Elective Compulsory Core qualification: Compulsory sh program): Specialisation E program): Specialisation E	nines from the inves.	e characters Enviromer eering: Elect Energy a al Engineerin Enviromer eering: Elect



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

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



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



Module M0934: Ad	Ivanced Materials			
Courses				
Title Advanced Materials Charac Advanced Materials Design Advanced Materials Design	(L1091)	<b>Typ</b> Lecture Lecture Recitation Section (large)	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible				
Admission Requirements	 			
Recommended Previous Knowledge	Fundamentals of Materials Science (I and I	I)		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	The students will be able to explain the pro- in technology, in particular metallic, ceran (biomaterials) and nanomaterials.	operties of advanced materials a nic, polymeric, semiconductor, m	along with th nodern com	neir applications posite materials
Skills	The students will be able to select mater necessary, to design new materials con macroscale. The students will also gain a them to select optimum materials combinat	nsidering architectural principle an overview on modern materia	es from the als science,	e micro- to the which enables
Personal Competence				
Social Competence	The students are able to present solutions	to specialists and to develop ide	as further.	
Autonomy	<ul> <li>The students are able to</li> <li>assess their own strengths and wea</li> <li>define tasks independently.</li> </ul>	uknesses.		
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German p Compulsory General Engineering Science (German pro Elective Compulsory General Engineering Science (English p Compulsory General Engineering Science (English pro Elective Compulsory Mechanical Engineering: Core qualification	ogram, 7 semester): Specialisatic rogram): Specialisation Mechan gram, 7 semester): Specialisatic	on Mechanio nical Engin	cal Engineering eering: Elective



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

Course L1091: 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: Advance	ourse L1092: Advanced Materials Design	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



## **Focus Biomechanics**

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

Courses				
Title 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	Hrs/wk 2 2 2	<b>CP</b> 2 1 2
Advanced Mechanical Engir	ieering Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical En</li> <li>Mechanics</li> <li>Fundamentals of Materials Scier</li> <li>Production Engineering</li> </ul>			
Educational Objectives	After taking part successfully, students h	ave 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 complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solvin skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss methods.</li> </ul>	technical information in the lectu	re supporte	d by activatii
Autonomy	<ul> <li>Students are able to independer</li> <li>Students are able to acquire a content e.g. by using the video re</li> </ul>	-	-	
Workload in Hours	Independent Study Time 68, Study Time	in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			
	General Engineering Science (Germa Energy Systems: Compulsory General Engineering Science (Germa		-	-

Aircraft Systems Engineering: Compulsory		I
General Engineering Science (German program): Specialisation Mechanical Engine	erina.	Focus
Materials in Engineering Sciences: Compulsory	eg,	
General Engineering Science (German program): Specialisation Mechanical Engine	erina.	Focus
Mechatronics: Compulsory	- 3,	
General Engineering Science (German program): Specialisation Mechanical Engine	ering,	Focus
Product Development and Production: Compulsory	0,	
General Engineering Science (German program): Specialisation Mechanical Engine	ering,	Focus
Theoretical Mechanical Engineering: Compulsory		
General Engineering Science (German program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Aircraft Systems Engineering: Compulsory		
General Engineering Science (German program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Materials in Engineering Sciences: Compulsory		
General Engineering Science (German program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Mechatronics: Compulsory	<b>-</b> .	
General Engineering Science (German program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Product Development and Production: Compulsory	<b>F</b> actions	
General Engineering Science (German program, 7 semester): Specialisation Mechanica Focus Theoretical Mechanical Engineering: Compulsory	Engine	ering,
General Engineering Science (German program, 7 semester): Specialisation Mechanica	Engine	oring
Focus Biomechanics: Compulsory	Lingine	, ening,
General Engineering Science (German program, 7 semester): Specialisation Mechanica	Engine	erina.
Focus Energy Systems: Compulsory	gc	, eg,
Assignment for the General Engineering Science (English program): Specialisation Mechanical Engine	ering,	Focus
Following Curricula Energy Systems: Compulsory	0.	
General Engineering Science (English program): Specialisation Mechanical Engine	ering,	Focus
Aircraft Systems Engineering: Compulsory		
General Engineering Science (English program): Specialisation Mechanical Engine	ering,	Focus
Materials in Engineering Sciences: Compulsory		
General Engineering Science (English program): Specialisation Mechanical Engine	ering,	Focus
Mechatronics: Compulsory		<b>F</b>
General Engineering Science (English program): Specialisation Mechanical Engine Product Development and Production: Compulsory	enng,	Focus
General Engineering Science (English program): Specialisation Mechanical Engine	orina	Focus
Theoretical Mechanical Engineering: Compulsory	ching,	10003
General Engineering Science (English program, 7 semester): Specialisation Mechanica	Engine	erina.
Focus Aircraft Systems Engineering: Compulsory	0	0,
General Engineering Science (English program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Materials in Engineering Sciences: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Mechatronics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanica	Engine	ering,
Focus Product Development and Production: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanica Focus Theoretical Mechanical Engineering: Compulsory	Engine	enng,
General Engineering Science (English program, 7 semester): Specialisation Mechanica	Engine	oring
Focus Biomechanics: Compulsory	Ligine	, enny,
General Engineering Science (English program, 7 semester): Specialisation Mechanica	Enaine	erina.
Focus Energy Systems: Compulsory	3.0	3,
Mechanical Engineering: Core qualification: Compulsory		
Naval Architecture: Core qualification: Compulsory		



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



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



rse L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
	Advanced Mechanical Engineering Design I & II Lecture
Content	<ul> <li>Fundamentals of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Seals</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> </ul> </li> <li>Elements of fluidics</li> </ul> Exercise <ul> <li>Calculation methods of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Sliding bearings</li> <li>Elements of fluidics</li> </ul> </li> <li>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>Gear drives</li> <li>Gear drives</li> <li>Gear drives</li> <li>Gear drives</li> <li>Sliding bearings</li> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul></li></ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springe Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuell Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



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



Module M1277: ME	D I: Introduction to Anatom	у		
Courses				
Title Introduction to Anatomy (L0384)		<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Udo Schumacher			
nequirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students	have reached the following le	arning results	
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeleta system. The students can describe the basic macroscopy and microscopy of those systems.			
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in curr professional level.	rent discussions in biomedic	al research and	medicine on a
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquire the relevant knowledge themselves.			
Workload in Hours	Independent Study Time 62, Study Tim	ne in Lecture 28		
Credit points	3			
Examination				
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical 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: Introduct	tion to Anatomy			
Тур	Lecture			
Hrs/wk	2			
СР				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Tobias Lange			
Language	DE			
Cycle	SoSe			
Content	General Anatomy1 st week:The Eucaryote Cell2 <sup>nd</sup> week:The Tissues3 <sup>rd</sup> week:Cell Cycle, Basics in Development4 <sup>th</sup> week:Musculoskeletal System5 <sup>th</sup> week:Cardiovascular System6 <sup>th</sup> week:Respiratory System7 <sup>th</sup> week:Genito-urinary System8 <sup>th</sup> week:Immune system9 <sup>th</sup> week:Digestive System I10 <sup>th</sup> week:Endocrine System12 <sup>th</sup> week:Kervous System			
Literature	13 <sup>th</sup> week:       Exam         Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012			

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Courses				
<b>Fitle</b> Signals and Systems (L043: Signals and Systems (L043:	,	<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is ex (Fourier series, Fourier transform, Laplace tra	pected. Further experience w	ith spectral	
Educational Objectives	After taking part successfully, students have r	eached 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			
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 asses the impact of LTI systems on the signal properties in time and frequency domain.			
Personal Competence				
Social Competence	The students can jointly solve specific proble	ns.		
Autonomy	The students are able to acquire relevant in control their level of knowledge during the le clicker system.			•
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	90 min General Engineering Science (German progr			
	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory	am): Specialisation Process E am): Specialisation Bioproces program): Specialisation	ingineering: s Engineerin Civil- and Mechanical al Engineerin	Compulsory ng: Compulso Enviroment Engineerin



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



urse L0432: Signals a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	4
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language	
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. Teubne Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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



Courses					
Title	d Radiation Therapy (L0383)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3	
Module Responsible	Prof. Ulrich Carl				
Admission Requirements					
Recommended Previous Knowledge	None				
Educational Objectives	After taking part successfully, students	have reached the following I	learning results		
	Professional Competence Therapy				
	The students can distinguish differer radiation therapy.	it types of currently used ec	quipment with respe	ct to its use	
	The students can explain treatment p surgery, internal medicine).	lans used in radiation thera	py in interdisciplinar	y contexts (e	
	The students can describe the patie care.	nts' passage from their initi	al admittance throu	gh to follow-	
	Diagnostics				
Knowledge	The students can illustrate the tea angiography and mammography, as w				
	The students can explain the diagnos the technical basis for those technique	-	e of imaging techniq	ues, as well	
	The students can choose the right tre	eatment method depending	on the patient's clin	ical history a	
	The student can explain the influence	of technical errors on the ima	iging techniques.		
	The student can draw the right conc protocol.	lusions based on the image	es' diagnostic findin	gs or the er	
	<b>Therapy</b> The students can distinguish curative conclusion.	e and palliative situations ar	nd motivate why the	ey came to th	
	The students can develop adequate th	erapy concepts and relate it	to the radiation biolo	gical aspects	
	The students can use the therapeutic p	principle (effects vs adverse e	effects)		
Skills	The students can distinguish different situation (location of the tumor) and ch			-	
	The student can assess what an in treatment, sports, social help groups, s				
	Diagnostics				
	The students can suggest solutions analyses.	for repairs of imaging instru	umentation after hav	ving done er	
	The students can classify results of based on their knowledge of anatomy			ps of diseas	
Personal Competence					
. si contai competente	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	cial, often fear-dominated b	ehavior of sick peo	ple caused	



Th	iagnostic and therapeutic measures and can meet them appropriately. he students can apply their new knowledge and skills to a concrete therapy case.
Th	
	he students can introduce younger students to the clinical daily routine.
Autonomy Th	he students are able to access anatomical knowledge by themselves, can participate competently in
со	onversations on the topic and acquire the relevant knowledge themselves.
Workload in Hours Inc	dependent Study Time 62, Study Time in Lecture 28
Credit points 3	
Examination W	
Examination duration and scale	0 minutes
Assignment for the Following Curricula Ge Bid Ge Bid Ge Fo Ge Co Co Bid Ge Bid Co Co Bid Co Co Bid Co Co Bid Co Co Bid Co Co Co Co Co Co Co Co Co Co Co Co Co	eneral Engineering Science (German program): Specialisation Mechanical Engineering, Focus iomechanics: Compulsory ieneral Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory ieneral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: ompulsory ieneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, ocus Biomechanics: Compulsory lectrical Engineering: Specialisation Medical Technology: Elective Compulsory ieneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus iomechanics: Compulsory ieneral Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory ieneral Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory ieneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; oocus Biomechanics: Compulsory ieneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; oopulsory ieneral Engineering: Specialisation Biomechanics: Compulsory iomedical Engineering: Specialisation Biomechanics: Compulsory iomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory iomedical Engineering: Specialisation Management and Business Administration: Elective ompulsory iomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective ompulsory iomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory



Hrs/wk       2         CP       3         Workload in Hours       Independent Study Time 62, Study Time in Lecture 28         Lecture       Prof. Ulrich Carl, Prof. Thomas Vestring         Cycel       SoSe         Cycet       SoSe         The students will be given an understanding of the technological possibiliti medical imaging, interventional radiology and radiation therapy/indiation assumed, that students in the beginning of the course have heard the word will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thom therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on which determine a predefined sequence in their respective departments         • "Technik der medizinischen Radiologie" von T. + J. Laubenberg         7. Auflage – Deutscher Ärzteverlag – erschienen 1999         • "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann un         4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006         ISBN: 978-3-437-23960-1         • "Strahlentherapie und Onkologie für MTA-R" von R. Sauer –         5. Auflage 2003 - Verlag Urban & Schwarzenberg         08.12.2009         ISBN: 978-3-437-47501-6         • "Taschenatlas der Physiologie" von S. Silbernagel und A.         8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012         ISBN: 978-3-13-567708-8         • "Der Körper des Menschen " von A. Faller u. M. Schünke -         16. Auflage 2004 – Georg Thieme Verl	
Workload in Hours         Independent Study Time 62, Study Time in Lecture 28           Lecturer         Prof. Ulrich Carl, Prof. Thomas Vestring           Language         DE           Cycle         SoSe           The students will be given an understanding of the technological possibiliti medical imaging, interventional radiology and radiation therapy/radiation assumed, that students in the beginning of the course have heard the word will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thom therapeutic (Prof. Dr. med. Unch Carl) use of X-rays. Both arms depend on which determine a predefined sequence in their respective departments           • "Technik der medizinischen Radiologie" von T. + J. Laubenberg         7. Auflage – Deutscher Ärzteverlag – erschienen 1999           • "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann um 4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006           ISBN: 978-3-437-23960-1         • "Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban & Schwarzenberg 08.12.2009           ISBN: 978-3-437-437501-6         • "Taschenatlas der Physiologie" von S. Silbernagel und A. 8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012           ISBN: 978-3-13-567708-8         • "Der Körper des Menschen" von A. Faller u. M. Schünke - 16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.20	
Lecturer         Prof. Ulrich Carl, Prof. Thomas Vestring           Language         DE           Cycle         SoSe           The students will be given an understanding of the technological possibilitim medical imaging, interventional radiology and radiation therapy/radiation assumed, that students in the beginning of the course have heard the word will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thom therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on which determine a predefined sequence in their respective departments           • "Technik der medizinischen Radiologie" von T. + J. Laubenberg           7. Auflage – Deutscher Ärzteverlag – erschienen 1999           • "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann un           4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006           ISBN: 978-3-437-23960-1           • "Strahlentherapie und Onkologie für MTA-R" von R. Sauer –           5. Auflage 2003 - Verlag Urban & Schwarzenberg           08.12.2009           ISBN: 978-3-437-47501-6           • "Taschenatlas der Physiologie" von S. Silbernagel und A.           8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012           ISBN: 978-3-13-567708-8           • "Der Körper des Menschen " von A. Faller u. M. Schünke -           16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.20           ISBN: 978-3-13-329716-5	
Language         DE           Cycle         SoSe           The students will be given an understanding of the technological possibilitimedical imaging, interventional radiology and radiation therapy/radiation assumed, that students in the beginning of the course have head the word will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thor therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on which determine a predefined sequence in their respective departments           • "Technik der medizinischen Radiologie" von T. + J. Laubenberg           7. Auflage – Deutscher Ärzteverlag – erschienen 1999           • "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann un           4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006           ISBN: 978-3-437-23960-1           • "Strahlentherapie und Onkologie für MTA-R" von R. Sauer –           5. Auflage 2003 - Verlag Urban & Schwarzenberg           08.12.2009           ISBN: 978-3-437-47501-6           • "Taschenatlas der Physiologie" von S. Silbernagel und A.           8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012           ISBN: 978-3-13-567708-8           • "Der Körper des Menschen " von A. Faller u. M. Schünke -           16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.20           ISBN: 978-3-13-329716-5	
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Literature       8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012         ISBN: 978-3-13-567708-8       • "Der Körper des Menschen " von A. Faller u. M. Schünke -         16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.20         ISBN: 978-3-13-329716-5	
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ISBN: 978-3-13-329716-5	
ISBN: 978-3-13-329716-5	112
	112
<ul> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer –</li> </ul>	
1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000	



Courses					
Title		Тур	Hrs/wk	СР	
Introduction to Biochemistry	and Molecular Biology (L0386)	Lecture	2	3	
	Prof. Hans-Jürgen Kreienkamp				
Admission Requirements	None				
Recommended Previous Knowledge	None				
Educational Objectives	After taking part successfully, students I	have reached the following le	earning 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	<ul> <li>The students can</li> <li>recognize the importance of molecular parameters for the course of a disease;</li> <li>describe selected molecular-diagnostic procedures;</li> <li>explain the relevance of these procedures for some diseases</li> </ul>				
Personal Competence					
Social Competence	The students can participate in discussions in research and medicine on a technical level.				
Autonomy	The students can develop understanding of topics from the course, using technical literature, by themselves.				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Credit points	3				
Examination					
Examination duration and scale	60 minutes				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineeri Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory			ng: Compulso cal Engineering cal Engineering ineering, Focu ng: Compulsor cal Engineering cal Engineering cal Engineering cal Engineering cal Engineering cal Engineering	

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



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> </ul>			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate t	his knowledg
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

	General Engineering Science (German program): Core qualification: Compulsory	I
	General Engineering Science (German program, 7 semester): Specialisation Computer Science:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:	
	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Energy and	
	Enviromental Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Mechatronics: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Aircraft Systems Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Materials in Engineering Sciences: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Product Development and Production: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	
	Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
Assignment for the		
Following Curricula	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	
		1
	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			
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	Typ Recitation Section (small)			
Hrs/wk	1			
СР	<b>CP</b> 2			
Workload in Hours	Workload in Hours Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Lecturer Prof. Heiko Falk			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			



Courses					
Title		Тур	Hrs/wk	СР	
Numerical Mathematics I (L0417) Numerical Mathematics I (L0418)		Lecture Recitation Section (small)	2 2	3 3	
	,	Heelialion deelion (small)	L	5	
Module Responsible Admission					
Requirements	None				
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Students (german or english) or Analysis &amp; Linear Algebra I + II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>				
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results		
Professional					
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> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computationa and storage complexitx.</li> </ul>				
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numerical methods using MATLAB,</li> <li>justify the convergence behaviour of numerical methods with respect to the problem an solution algorithm,</li> <li>select and execute a suitable solution approach for a given problem.</li> </ul>				
Personal Competence					
	Students are able to				
Social Competence	<ul> <li>work together in heterogeneously composed teams (i.e., teams from different study program and background knowledge), explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms.</li> </ul>				
	Students are capable				
Autonomy	• to assess whether the supporting theoretical and practical excercises are better solve				
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56			
Credit points					
Examination					
Examination duration	90 minutes				
	General Engineering Science (German pro General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compu General Engineering Science (German pro General Engineering Science (German Compulsory	program): Specialisation Mech program): Specialisation Mech Ilsory ogram): Specialisation Biomedica	anical Engii anical Engii al Engineerir	neering, Focu neering, Focu ng: Compulso	



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

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



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



Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
-			_	_
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems	s in time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to	p jointly solve technical problems, a	and experim	entally validat
Autonomy	their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in House	Indonandant Study Time 104 Study Ti	mo in Locturo 56		
Credit points	Independent Study Time 124, Study Ti			
-	Written exam			
Examination duration and scale				
	General Engineering Science (Germar General Engineering Science (Germ Compulsory General Engineering Science (Germa	an program, 7 semester): Special	isation Con	

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



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

Course L0654: Introduct	ion to Control Systems		
Тур	Lecture		
Hrs/wk	2		
СР	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	<u> </u>		
Cycle	WiSe		
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Vyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Simith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course		
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>		



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



DI: Implants and Fracture Healing				
ng (L0376)	<b>Typ</b> Lecture	<b>Hrs/wk</b> 2	<b>СР</b> 3	
Prof. Michael Morlock				
None				
It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".				
After taking part successfully, students have read	ched the following learning	results		
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.				
The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.				
The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.				
The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.				
Independent Study Time 62, Study Time in Lecture 28				
3				
Written exam				
90 min				
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 Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Biomechanics: 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 Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Administration: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				
	Fracture Healing". After taking part successfully, students have read The students can describe the different way existence. The students can name different treatments for morphologies. The students can determine the forces acting under specific assumptions. The students can, in groups, solve basic numeric The students can, in groups, solve basic numeric Independent Study Time 62, Study Time in Lectur 3 Written exam 90 min General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (English program General Engineering Science (English program Focus Biomechanics: Compulsory General Engineering: Specialisation Biomeco Biomedical Engineering: Specialisation Artifi Compulsory Biomedical Engineering: Specialisation Implants Biomedical Engineering: Specialisation Medical Biomedical Engineering: Specialisation Medical	Typ           Ing (L0376)         Lecture           Prof. Michael Morlock         None           It is recommended to participate in "Introduction into Anatomie" before Fracture Healing".         After taking part successfully, students have reached the following learning           The students can describe the different ways how bones heal, and sexistence.         The students can name different treatments for the spine and hollow be morphologies.           The students can, in groups, solve basic numerical modeling tasks for the cat independent Study Time 62, Study Time in Lecture 28         S           Written exam         90 min         General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Biomedica General Engineering Science (English program): Specialisation Mecha Biomechanics: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Mecha Biomechanics: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Mecha Biomechanics: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Focus Biomechanics: Compulsory           General Engineering Science (English program, 7 semester): Specialisation Focus Biomechanics: Compulsory           General Engineering Science (Engl	Typ         Hrs/wk           Ig (L0376)         Lecture         2           Prof. Michael Morlock	



Course L0376: Implants	and Fracture Healing
Тур	Lecture
Hrs/wk	2
СР	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Michael Morlock
Language Cycle	
	Topics to be covered include:
	1. Introduction (history, definitions, background importance)
	2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
	3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)
	3.1 The spine in its entirety
	3.2 Cervical spine
	3.3 Thoracic spine
	3.4 Lumbar spine
	3.5 Injuries and diseases
	4. Pelvis (anatomy, biomechanics, fracture treatment)
Content	5 Fracture Healing
	5.1 Basics and biology of fracture repair
	5.2 Clinical principals and terminology of fracture treatment
	5.3 Biomechanics of fracture treatment
	5.3.1 Screws
	5.3.2 Plates
	5.3.3 Nails
	5.3.4 External fixation devices
	5.3.5 Spine implants
	6.0 New Implants
	Cochran V.B.: Orthopädische Biomechanik
	Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics
	White A.A., Panjabi M.M.: Clinical biomechanics of the spine
	Nigg, B.: Biomechanics of the musculo-skeletal system
Literature	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat



Module M1280: ME	ED II: Introduction to Physiology
•	
Title Introduction to Physiology (L	Typ         Hrs/wk         CP           .0385)         Lecture         2         3
Module Responsible	Dr. Roger Zimmermann
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<ul> <li>The students can</li> <li>describe the basics of the energy metabolism;</li> <li>describe physiological relations in selected fields of muscle, heart/circulation, neuro- a sensory physiology.</li> </ul>
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and process of information, development of forces and vital functions) and relate them to similar technical system
Personal Competence	
Social Competence	The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrologic
Autonomy	The students can derive answers to questions arising in the course and other physiological are using technical literature, by themselves.
	Independent Study Time 62, Study Time in Lecture 28
Credit points	
Examination	
Examination duration and scale	60 minutes
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compuls 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, For Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compuls Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compuls Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elect Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



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



DI: Experimental Methods	in Biomechanics		
mechanics (L0377)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Prof. Michael Morlock			
None			
It is recommended to participate in Methoden".	"Implantate und Frakturheilung" t	pefore attending	"Experimentell
After taking part successfully, studer	nts have reached the following lea	rning results	
existence. The students can name different t morphologies. The students can describe different	reatments for the spine and hold	low bones under	r given fractur
The students can describe the biomechanics.	basic handling of several exp	perimental techn	iques used i
The students can, in groups, solve b	asic experimental tasks.		
The students can, in groups, solve b	asic experimental tasks.		
Independent Study Time 62, Study T	Time in Lecture 28		
3			
Written exam			
90 min			
Biomechanics: Compulsory General Engineering Science (Gern General Engineering Science (Gern Focus Biomechanics: Compulsory General Engineering Science (Gern Compulsory General Engineering Science (Engl General Engineering Science (Engl General Engineering Science (Engl Focus Biomechanics: Compulsory General Engineering Science (Engl Focus Biomechanics: Compulsory General Engineering Science (Engl Focus Biomechanics: Compulsory General Engineering Science (Engl Compulsory Mechanical Engineering: Specialisa Biomedical Engineering: Specialisa Biomedical Engineering: Specialisa Biomedical Engineering: Specialisa Biomedical Engineering: Specialisa	nan program): Specialisation Biom nan program, 7 semester): Specia nan program, 7 semester): Specia ish program): Specialisation Biom nglish program): Specialisation I ish program, 7 semester): Special lish program, 7 semester): Special tion Biomechanics: Compulsory sation Artificial Organs and Re tion Implants and Endoprostheses tion Medical Technology and Con	nedical Engineerin lisation Mechanic disation Biomedic edical Engineerin Mechanical Engi lisation Mechanic lisation Biomedic egenerative Mec s: Elective Compu- trol Theory: Elect	ng: Compulso cal Engineerin cal Engineerin ng: Compulsor neering, Focu cal Engineerin cal Engineerin dicine: Electiv llsory
	mechanics (L0377) Prof. Michael Morlock None It is recommended to participate in Methoden". After taking part successfully, studer The students can describe the d existence. The students can describe different t morphologies. The students can describe different t the adequate technique for a given t The students can, in groups, solve b The students can, in groups, solve b Independent Study Time 62, Study T 3 Written exam 90 min General Engineering Science (Gen Biomechanics: Compulsory General Engineering Science (Gen Focus Biomechanics: Compulsory General Engineering Science (Engl Gompulsory General Engineering Science (Engl Gompulsory Mechanical Engineering: Specialisa Biomedical Engineering	mechanics (L0377)         Lecture           Prof. Michael Morlock         None           It is recommended to participate in "Implantate und Frakturheilung" I Methoden".         After taking part successfully, students have reached the following lead           The students can describe the different ways how bones heal, existence.         The students can ame different treatments for the spine and hol morphologies.           The students can describe different measurement techniques for force the adequate technique for a given task.         The students can describe the basic handling of several exploimechanics.           The students can, in groups, solve basic experimental tasks.         Independent Study Time 62, Study Time in Lecture 28           3         Written exam           90 min         General Engineering Science (German program): Specialisation I biomechanics: Compulsory           General Engineering Science (German program): Specialisation I biomechanics: Compulsory         General Engineering Science (German program): Specialisation I biomechanics: Compulsory           General Engineering Science (English program): Specialisation I biomechanics: Compulsory         General Engineering Science (English program): Specialisation I biomechanics: Compulsory           General Engineering Science (English program): Specialisation I biomechanics: Compulsory         General Engineering Science (English program): Specialisation I biomechanics: Compulsory           General Engineering Science (English program): Specialisation I biomechanics: Compulsory         General Engineering Science (English pr	Typ         Hrs/wk           mechanics (L0377)         Lecture         2           Prof. Michael Morlock         None



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



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



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

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



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



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

Т



## 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: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs we examination according to the following rules</li> <li>1. Upon a passed module examination marks due to the successful labs, so respectively, up to the next-better grade</li> <li>2. The improvement of the grade 5,0 up</li> </ul>	n, the student is granted a bo uch that the examination's ma ade.	onus on the rks are lifte	e examination
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence Knowledge	<ul> <li>This module deals with the foundations of t from the assembly-level programming down</li> <li>Introduction</li> <li>Combinational logic: Gates, Bool combinational networks</li> <li>Sequential logic: Flip-flops, automata</li> </ul>	to gates. The module includes ean algebra, Boolean functi a, systematic hardware design	the followin ons, hardw	g topics:
	<ul> <li>Basics of computer architecture: pipelining</li> <li>Memories: Memory hierarchies, SRA</li> <li>Input/output: I/O from the perspective connections, busses</li> </ul> The students perceive computer systems from structure and the physical composition of of specific and individual computers can be be They are able to distinguish between and	Programming models, MIPS M, DRAM, caches we of the CPU, principles of p om the architect's perspective, i. computer systems. The student uilt based on a collection of fer ad to explain the different ab	single-cycl assing data e., they ider s can analy w and simp	a, point-to-poin ntify the interna /ze, how high le components
Skills	computing systems - from gates and circuits After successful completion of the module between a physical computer system and understand the consequences that the exec layers from the assembly language down	e, the students are able to juc d the software executed on i cution of software has on the h	t. In partici ardware-cei	ular, they sha ntric abstractic



Personal Competence           Social Competence         Students are able to solve similar problems alone or in a group and to present           Students are able to acquire new knowledge from specific literature and to a           Autonomy           with other classes.           Workload in Hours           Independent Study Time 124, Study Time in Lecture 56           Credit points           Examination           Written exam           Examination duration and scale           90 minutes, contents of course and labs           General Engineering Science (German program): Core qualification: Compuls General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation Compulsory           General Engineering Science (German program, 7 semester): Specialisation Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation N Focus Mechatronics: Compulsory	
Social Competence         Students are able to solve similar problems alone or in a group and to present           Students are able to acquire new knowledge from specific literature and to a           Autonomy           with other classes.           Workload in Hours           Independent Study Time 124, Study Time in Lecture 56           Credit points           Examination           Written exam           Examination duration and scale           90 minutes, contents of course and labs           General Engineering Science (German program): Core qualification: Compuls General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semeste	
Autonomy       with other classes.         Workload in Hours       Independent Study Time 124, Study Time in Lecture 56         Credit points       6         Examination       Written exam         Examination duration and scale       90 minutes, contents of course and labs         General Engineering Science (German program): Core qualification: Compuls General Engineering Science (German program, 7 semester): Specialisation I Compulsory         General Engineering Science (German program, 7 semester): Specialisation I Compulsory       General Engineering Science (German program, 7 semester): Specialisation I Compulsory         General Engineering Science (German program, 7 semester): Specialisation Compulsory       General Engineering Science (German program, 7 semester): Specialisation Compulsory         General Engineering Science (German program, 7 semester): Specialisation Compulsory       General Engineering Science (German program, 7 semester): Specialisation I Compulsory         General Engineering Science (German program, 7 semester): Specialisation I Compulsory       General Engineering Science (German program, 7 semester): Specialisation I Compulsory         General Engineering Science (German program, 7 semester): Specialisation I Compulsory       General Engineering Science (German program, 7 semester): Specialisation I Compulsory         General Engineering Science (German program, 7 semester): Specialisation I Compulsory       General Engineering Science (German program, 7 semester): Specialisation I Focus Mechatronics: Compulsory         General Engineering Scie	ssociate this knowledge
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Examination         Written exam           Examination duration and scale         90 minutes, contents of course and labs           General Engineering Science (German program): Core qualification: Compuls General Engineering Science (German program, 7 semester): Specialisat Compulsory           General Engineering Science (German program, 7 semester): Specialisation I Compulsory           General Engineering Science (German program, 7 semester): Specialisat Compulsory           General Engineering Science (German program, 7 semester): Specialisat Compulsory           General Engineering Science (German program, 7 semester): Specialisat Compulsory           General Engineering Science (German program, 7 semester): Specialisation Compulsory           General Engineering Science (German program, 7 semester): Specialisation N Focus Mechatronics: Compulsory           General Engineering Science (German program, 7 semester): Specialisation N Focus Biomechanics: Compulsory           General Engineering Science (German program, 7 semester): Specialisation N Focus Biomechanics: Compulsory           General Engineering Science (German program, 7 semester): Specialisation N Focus Aircraft Systems Engineering: Compulsory	
Examination duration and scale         90 minutes, contents of course and labs           General Engineering Science (German program): Core qualification: Compuls General Engineering Science (German program, 7 semester): Specialisat Compulsory General Engineering Science (German program, 7 semester): Specialisation Compulsory General Engineering Science (German program, 7 semester): Specialisation I Compulsory General Engineering Science (German program, 7 semester): Specialisation I Compulsory General Engineering Science (German program, 7 semester): Specialisation Compulsory General Engineering Science (German program, 7 semester): Specialisation Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Materials in Engineering Sciences: Compulsory	
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Assignment for the Following CurriculaGeneral Engineering Science (German program, 7 semester): Specialisation M Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation M Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (english program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation M General Engineering Science (English program, 7 semester): Specialisation F Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineer	ion Computer Science: Bioprocess Engineering: ion Naval Architecture: tion Civil Engineering: Electrical Engineering: Biomedical Engineering: alisation Energy and n Process Engineering, Mechanical Engineering; Mechanical Engineering; Mechanical Engineering; Mechanical Engineering; Mechanical Engineering; Mechanical Engineering; Mechanical Engineering; Electrical Engineering: Electrical Engineering:
Compulsory General Engineering Science (English program, 7 semester): Specialisation E Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisatio Compulsory General Engineering Science (English program, 7 semester): Specialisation N	nergy and Enviromental n Process 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: 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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	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering. Core quanication. Compulsory
i oliowing curricula	General Engineering Science (English program). Specialisation Civil- and Environmental Engeneering.
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
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	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
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	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
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	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
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	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



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



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



Courses				
<b>Fitle</b> Heat Transfer (L0458) Heat Transfer (L0459)		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 3 2	<b>CP</b> 4 2
	Dr. Andreas Moschallski	(		
Admission Requirements				
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid I	Dynamics		
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional Competence				
	The students are able to			
	- describe the different physical mechanism	m of Heat Transfer,		
Knowledge	- explain the technical terms,			
	- to analyse comlex heat transfer processe	s in a critical 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 groups.			
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 problem self-consistent and analyse the results in critical way. A qualified exchange with other students is given.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
	Written exam			
Examination duration and scale	120 min			
Assignment for the	General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German Energy Systems: Compulsory General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Focus Energy Systems: Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German pro Compulsory General Engineering Science (English pro	program): Specialisation Mecha ogram): Specialisation Biomedica program): Specialisation Mecha pulsory ogram, 7 semester): Specialisatic g: Compulsory ogram, 7 semester): Specialisatic gram, 7 semester): Specialisatic	anical Engi al Engineeri anical Engi on Mechanic on Mechanic on Biomedic I Engineerir	neering, Foo ng: Compulso neering, Foo cal Engineerin cal Engineerin cal Engineerin cal Engineerin
-	General Engineering Science (English	program): Specialisation Mecha	anical Engi	neering, Foo



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

Course L0458: Heat Tra	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	)E			
Cycle	WiSe			
Content	Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods			
Literature	<ul> <li>Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014</li> <li>Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000</li> <li>Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996</li> </ul>			

Course L0459: Heat Tra	Course L0459: Heat Transfer			
Тур	Recitation Section (large)			
Hrs/wk	2			
CP	2			
Workload in Hours	pendent 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 Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 4
		Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in t	ime and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students hav	e 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 ar frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally valida their controller designs Students can obtain information from provided sources (lecture notes, software documentatio experiment guides) and use it when solving given problems.			
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning pro			
Workload in Hours	Independent Study Time 124, Study Time	n Lecture 56		
Credit points	6			
Examination Examination duration	Written exam 120 min			
and scale	General Engineering Science (German pro General Engineering Science (German Compulsory General Engineering Science (German pro	program, 7 semester): Speciali	sation Con	

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



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

Course L0654: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Root locus stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Root locus and frequency response of time delay systems Root locus and frequency response of time delay systems Simith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Courses				
Title         Advanced Mechanical Engineering Design II (L0264)         Advanced Mechanical Engineering Design II (L0265)         Advanced Mechanical Engineering Design I (L0262)         Advanced Mechanical Engineering Design I (L0263)		<b>Typ</b> Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 2 2 2 2	<b>CP</b> 2 1 2 1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical Eng</li> <li>Mechanics</li> <li>Fundamentals of Materials Science</li> <li>Production Engineering</li> </ul>			
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 complex working principles and functions of machine elements and of basic elemen of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples of complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are all</li> <li>accomplish dimensioning calcula</li> <li>transfer knowledge learned in the skills),</li> <li>recognize the content of technical</li> <li>evaluate complex designs, technical</li> </ul>	tions of covered machine element ne module to new requirements a drawings and schematic sketches	and tasks (j	problem solvir
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss te methods.</li> </ul>	echnical information in the lectur	re supporte	ed by activatir
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 understoo 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				
	Written exam			
Examination duration and scale	120			
	General Engineering Science (German Energy Systems: Compulsory General Engineering Science (German Aircraft Systems Engineering: Compulson General Engineering Science (German Materials in Engineering Sciences: Comp General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German Product Development and Production: Co	n program): Specialisation Mech ry n program): Specialisation Mech pulsory n program): Specialisation Mech n program): Specialisation Mech	anical Eng anical Eng anical Eng	ineering, Focu ineering, Focu ineering, Focu



	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
Assignment for the	Focus Energy Systems: Compulsory
Following Curricula	constal Engineering Colonee (English program): Specialeation meenanear Engineering, result
	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 Sciences (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



Typ Hrs/wk	Lecture	
HIS/WK		
CP		
	Independent Study Time 32, Study Time in Lecture 28	
	Prof. Dieter Krause, Prof. Otto von Estorff	
Language		
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 Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Gear drives • Belt & chain drives • Gear drives • Gear drives • Gear drives • Sliding bearings • Crank gears • Sliding bearings • Calculations of hydrostatic systems (fluidics)	
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springvieweg, aktuelle Auflage.</li> </ul>	



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



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



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



Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynami		Lecture	2	3
Computational Fluid Dynami	cs I (L0419)	Recitation Section (large)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence		erics of partial differential equation	ons.	
Knowledge	The students are able to list the basic numerics of partial differential equations.			
Skills	The students are able develop appropriat partial differential equations. They can coc			-
Personal Competence Social Competence Autonomy	The students can arrive at work results in g The students can independently analyse a		oblems.	
Workload in Hours	Independent Study Time 124, Study Time	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h			
-	General Engineering Science (German program): Specialisation Mechanical Engineering, For Energy Systems: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Maval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Foc Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory Naval Architecture: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			



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

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



Courses				
Title Gas and Steam Power Plan Gas and Steam Power Plan		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 2	<b>CP</b> 4 2
Module Responsible		noonalion coolion (largo)	-	-
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>"Technical Thermodynamics I a</li> <li>"Heat Transfer"</li> <li>"Fluid Mechanics"</li> </ul>	und II"		
Educational Objectives	After taking part successfully, students	have reached the following learning	g 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 conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage.			
Skills	The students will be able, using theories and methods of the energy technology from fossil fuels an based on well-founded knowledge on the function and construction of gas and steam power plants, identify basic associations in the production of heat and electricity, so as to develop conceptus solutions. Through analysis of the problem and exposure to the inherent interplay between heat an power generation the students are endowed with the capability and methodology to develop realist optimal concepts for the generation of electricity and the production of heat. From the technical basic 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 suit EBSILON Professional <sup>TM</sup> . With this tool small practical tasks are solved with the PC, to highlig aspects of the design and development of power plant cycles.			
Deve and Competence				
Personal Competence	An excursion within the framework of the lecture is planned for students that are interested. The students get in this manner direct contact with a modern power plant in this region. The students we			
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 stean power plants and calculate selected quantities and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time	me in Lecture 70		
Credit points	6			
Examination	Written exam			



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



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



Course L0210: Gas and	Steam Power Plants		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
	Prof. Alfons Kather		
Language			
Cycle			
Cycle	<ul> <li>Wise</li> <li>In the 1<sup>st</sup> part of the lecture a general introduction into fluid-flow machines and steam power plants i offered, including:</li> <li>Energy balance of a fluid-flow machine</li> <li>Theory of turbine and compressor stage</li> <li>Equal and positive pressure blading</li> <li>Flow losses</li> <li>Characteristic numbers</li> <li>Axial and radial design</li> <li>Design features</li> <li>Hydraulic fluid-flow machines</li> <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> <li>Disel engine systems</li> <li>Waste heat utilisation</li> <li>followed by the more specialised issues:</li> <li>Electricity Demand and Forecasting</li> <li>Thermodynamic fundamentals</li> <li>Energy Conversion in Thermal Power Plants</li> <li>Types of Power Plant</li> <li>Layout of the power plant block</li> <li>Individual elements of the power plant</li> <li>Cooling systems</li> <li>Flue gas cleaning</li> <li>Operation characteristics of the power plant</li> <li>Construction materials</li> <li>Location of power plants</li> <li>Location of power plants</li> <li>Construction materials</li> <li>Location characteristics of the lecture and the lecture hall exercise. The challenges in plant preventional power plants and renewable energy sources ar discussed and the technical options for providing security of supply and network stability an presented, also under consideration of cost effectiveness. In this critical review, focus is especial placed on the compatibility of the different solutions with the environment and climate. With this, this awareness for the responsibility of an engineer's own actions are emphasized and the potential exercise of the different solutions are solved on the PC, to highlight aspects of the design state solved on the PC, to highlight aspects of the design state states are a special clearly.</li> </ul>		
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		Тур	Hrs/wk	СР
Engines (LU633)	ting Engines and Turbomachinery - Part Recipr	ocating Lecture	1	1
Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Recitation Section (large) 1 1 Engines (L0634)				1
Internal Combustion Engines I (L0059)Lecture22Internal Combustion Engines I (L0639)Recitation Section (large)12				
Module Responsible	Prof. Christopher Friedrich Wirz			
Admission Requirements	None			
Recommended Previous Knowledge	Thermodynamics, Mechanics, Machine Eler	nents		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	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.			
Skills	operational problems and to perform mechanical and thermodynamic design.			
Personal Competence				
Social Competence	The students are able to communicate and machinery design and application.	d cooperate in a professional	environmer	it in the field
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			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory			



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

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

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



Course L0059: Internal C	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 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	

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Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management Project Entrepreneurship (LI		<b>Typ</b> Lecture Project-/problem-based Learning	<b>Hrs/wk</b> 3 2	<b>CP</b> 3 3
Madala Davasa iki		Learning		
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge		ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				D
Knowledge	<ul> <li>Management, from Planning and Organis. and Controlling. In particular they are able</li> <li>explain the differences between Management and to name importar</li> <li>explain the most important aspects aspects of entreprneurial projects</li> <li>describe and explain basic busin supply chain management, organ management, innovation managem</li> <li>explain the relevance of planning multiple objectives and uncertaint Finance</li> <li>state basics from accounting and compared</li> </ul>	Economics and Management t definitions from the field of Ma of and goals in Management a ess functions as production, ization and human ressource ent and marketing and decision making in Busine y, and explain some basic r	and the su nagement nd name the procurement e manageme ess, esp. in s nethods fror	b-disciplines ir most importan t and sourcing ent, information situations under
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under risk</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the l report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their formation in the statement of the statement of</li></ul>	ecture to an entrepreneurship	project and v	vrite a coheren
Autonomy	Students are able to <ul> <li>work in a team and to organize the t</li> <li>to write a report on their project.</li> </ul>	eam themselves		
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



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

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



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



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



Module M0618: Re	enewables and Energy Systems			
Courses				
<b>Title</b> Power Industry (L0316) Energy Systems and Energy	y Industry (L0315)	<b>Typ</b> Lecture Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 2
Renewable Energy (L0313) Renewable Energy (L1434)		Lecture Recitation Section (small)	2 1	2 1
-	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	With completion of this module, the students systems and their economic efficiency. The Furthermore, they can explain details of power regard to subject-related contexts. The student many energy systems in general, especially fo Furthermore, the students can explain the envir	y can explain the issues r generation, power distribut tts can explain these aspect r renewable energy systems	occurring ion and po ts, which a s and critica	in this context wer trading wil 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 tec	inability aspects. This allows		
Autonomy	Students can independently exploit sources , a and transform it to new questions.	cquire the particular knowled	dge about t	he subject are
Workload in Hours	Independent Study Time 96, Study Time in Lect	ture 84		
Credit points	6			
	Written exam			
Examination duration and scale	3 hours written exam			
	General Engineering Science (German p Engineering: Compulsory General Engineering Science (German p Enviromental Engineering: Compulsory General Engineering Science (German prograr Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core of General Engineering Science (English program Engineering: Compulsory General Engineering Science (English program	rogram, 7 semester): Sp n, 7 semester): Specialisatio qualification: Compulsory rogram): Specialisation En	n Mechanic nergy and	n Energy an cal Engineering I Enviromenta



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

Course L0316: Power In	dustry
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> </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: Renewab	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 - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage</li> <li>Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007</li> </ul>

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



## Focus Aircraft Systems Engineering

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

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

## Module M0597: Advanced Mechanical Engineering Design

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engin	• • • •	Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large)	2	1
Advanced Mechanical Engin	0 0 ( )		2	2
Advanced Mechanical Engin	leering Design I (L0263)	Recitation Section (large)	2	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanica</li> <li>Mechanics</li> <li>Fundamentals of Materials S</li> <li>Production Engineering</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, studen	nts have reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>transfer knowledge learned skills),</li> </ul>	Iculations of covered machine elemen in the module to new requirements nical drawings and schematic sketche	and tasks (	oroblem solvii
Personal Competence				
Social Competence	<ul> <li>Students are able to discumethods.</li> </ul>	ss technical information in the lectu	ure supporte	d by activatir
Autonomy		idently deepen their acquired knowled re additional knowledge and to rec eo recordings of the lectures.	•	
Workload in Hours	Independent Study Time 68, Study T	Time in Lecture 112		
Credit points	6			

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



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



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



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



	Lecture
Hrs/wk	
СР	
	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
Content	<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>Gear drives</li> <li>Epicyclic gears</li> <li>Crank drives</li> <li>Sliding bearings</li> <li>Elements of fluidics</li> </ul>
	<ul> <li>Exercise</li> <li>Calculation methods of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>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, 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., Spring Vieweg, aktuelle Auflage.</li> </ul>



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



Courses			
<b>Title</b> Signals and Systems (L0432	32) Typ Hrs/wk	<b>CP</b> 4	
Signals and Systems (L043)	,	2	
	Prof. Gerhard Bauch		
Admission			
Requirements	None		
	Mathematics 1-3		
	d The modul is an introduction to the theory of signals and systems. Good knowled covered by the moduls Mathematik 1-3 is expected. Further experience with spectral (Fourier series, Fourier transform, Laplace transform) is useful but not required.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional			
Competence			
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 asses the impact of LTI systems on the signal properties in time and frequency domain.		
Personal Competence			
Social Competence	The students can jointly solve specific problems.		
Autonomy	The students are able to acquire relevant information from appropriate literature so control their level of knowledge during the lecture period by solving tutorial problems clicker system.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
	s 6		
Credit points			
Examination	n Written exam		
•	n Written exam		



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



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



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



Courses				
Title Advanced Mechanical Design Project (L0266)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Dr. Jens Schmidt			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mechanical Engineering: Design</li> <li>Advanced Mechanical Engineering I</li> </ul>	Design		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence	After passing the module, students are able	to:		
Knowledge	<ul> <li>express the procedure for systematically handling of</li> <li>complex design tasks ,</li> <li>describe working principles, their use and combination possibilities,</li> <li>explain guidelines for designing for function and manufacturing,</li> <li>explain advanced use-oriented knowledge of machine elements.</li> </ul>			
Skills	<ul> <li>After passing the module, students are able 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 solutio oriented,</li> <li>create a technical documentation including all necessary technical drawings to understand th functions of the system,</li> <li>document calculations of selected machine elements clearly and in detail.</li> </ul>			
Personal Competence				
Social Competence	After passing the module, students are able to:			
Autonomy	<ul> <li>After passing the module, students are able</li> <li>independently solve complex des necessary knowledge and selecting</li> <li>to independently solve problems.</li> </ul>	sign projects, while motivati	ing themse	lves, acquirir
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180			
	General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German p Product Development and Production: Comp General Engineering Science (German p Theoretical Mechanical Engineering: Compu General Engineering Science (German prog Focus Aircraft Systems Engineering: Compu General Engineering Science (German prog Focus Product Development and Production	rogram): Specialisation Mech pulsory rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatio Isory gram, 7 semester): Specialisatio	anical Eng anical Eng on Mechanic	ineering, Focu ineering, Focu cal Engineerin

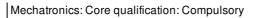


Assignment for the<br/>Following CurriculaGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,<br/>Focus Theoretical Mechanical Engineering: Compulsory<br/>General Engineering Science (English program): Specialisation Mechanical Engineering, Focus<br/>Aircraft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

Course L0266: Advanced Mechanical Design Project			
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	<ul> <li>Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.</li> <li>Getriebekonstruktion in Einzelarbeit <ul> <li>Erarbeitung von Lösungsprinzipien</li> <li>Berechnung von Maschinenelementen</li> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> <li>Erstellung einer ausführlichen Dokumentation</li> </ul> </li> <li>Lösungsfindung <ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> <li>Erstellen einer Dokumentation</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); 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 Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	chatronic Systems (L1823)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible	Prof. Uwe Weltin			
A dunia cie u	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory and	electrical engineering		
Educational Objectives	After taking part successfully, students have read	hed the following learning	results	
Professional Competence <i>Knowledge</i>	Students are able to describe methods and optimization of mechatronic systems.	calculations for design,	modeling,	simulation a
Skills	Students are able to apply modern algorithms fo simulate and design simple systems and implem			ney can ident
Personal Competence				
Social Competence	Students are able to work goal-oriented in small			rget groups.
Autonomy	Students are able to recognize and improve know With instructor assistance, students are able to further course of study.		-	el and define
Workload in Hours	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German progra Mechatronics: Compulsory General Engineering Science (German progra Aircraft Systems Engineering: Compulsory General Engineering Science (German progra Theoretical Mechanical Engineering: Compulsor General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Elec General Engineering Science (English progra Aircraft Systems Engineering: Compulsory General Engineering Science (English progra Mechatronics: Compulsory General Engineering Science (English progra Theoretical Mechanical Engineering: Compulsor General Engineering Science (English program Focus Mechatronics: Compulsory General Engineering Science (English program Focus Aircraft Systems Engineering: Compulsor General Engineering Science (English program Focus Theoretical Mechanical Engineering: Elec Mechanical Engineering: Specialisation Aircraft Mechanical Engineering: Specialisation Mechatt Mechanical Engineering: Specialisation Theoret	am): Specialisation Mechan): Specialisation Mechany, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisation, am): Specialisation Mechanan): Specialisation Mechananan): Specialisation Mechananananananananananananananananananan	anical Engi anical Engi on Mechanic on Mechanic on Mechanic anical Engi anical Engi on Mechanic on Mechanic on Mechanic	neering, Foc neering, Foc al Engineerir al Engineerir al Engineerir neering, Foc neering, Foc al Engineerir al Engineerir al Engineerir



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

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

Course L1824: Simulation	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 Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible		, , , , , , , , , , , , , , , , , , ,		
Admission				
Requirements	None			
Recommended Previous Knowledge		time and frequency domain, Lap	lace transfor	m
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo	intly solve technical problems,	and experim	entally validat
Autonomy	their controller designs Students can obtain information from provided sources (lecture notes, software documentatio experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Examination Examination duration and scale	Written exam 120 min			
	General Engineering Science (German pr General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Specia	lisation Com	

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



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

Course L0654: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Kyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Simit predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 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	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
<b>Title</b> Computer Engineering (L032 Computer Engineering (L032	1)	<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible		(		_
A dunia nin u	None			
Requirements	None			
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional				
Competence	This module deals with the foundations of the fund	ationality of computing -	votome It	voro the love
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware 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>			
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.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone of	or in a group and to pres	ent the resul	ts accordingly
	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

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



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

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

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



Courses				
<b>Title</b> CAE-Team Project (L0271)		<b>Typ</b> Project-/problem-based Learning	<b>Hrs/wk</b> 2	<b>CP</b> 2
Development of Lightweight Integrated Product Develop		Lecture Lecture	2 2	2 2
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
	Advanced Knowledge about engine	ering design:		
Decommended	Fundamentals of Mechanical Engine	ering Design		
Recommended Previous Knowledge	Mechanical Engineering: Design			
	Advanced Mechanical Engineering I	Design		
Educational Objectives	After taking part successfully, studen	ts have reached the following learning	results	
Professional Competence				
	After completing the module, student	ts are capable of:		
Knowledge	<ul> <li>explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems</li> <li>describing the interaction of the different CAE-Systems in the product development process</li> </ul>			
	After completing the module, student	ts are able to:		
Skills	<ul> <li>evaluate different CAD- and PDM-Systems with regards to the desired requirements such a classification schemes and product structuring</li> <li>design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload</li> </ul>			
Personal Competence				
	After completing the module, student	ts are able to:		
Social Competence	<ul> <li>To develop a project plan and allocate work appropriate work packages in the framework o group discussions</li> <li>Present project results as a team for instance in a presentation</li> </ul>			
	Students are capable of:			
Autonomy		E-Tool and complete a given practical	task with it	
Workload in Hours	Independent Study Time 96, Study T	ime in Lecture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90			
	Aircraft Systems Engineering: Comp General Engineering Science (Ge Product Development and Productio	rman program): Specialisation Mech n: Compulsory an program, 7 semester): Specialisati Compulsory	nanical Engi on Mechanic	ineering, Foci cal Engineerin



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

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



Course L0270: 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: Integrated Product Development I			
Тур	Lecture		
Hrs/wk			
СР			
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: Ae	ronautical Systems			
Courses				
Title Fundamentals of Aircraft Sy Fundamentals of Aircraft Sy Air Transportation Systems Air Transportation Systems	stems (L0742) (L0591)	<b>Typ</b> Lecture Recitation Section (small) Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 1 2 1	<b>CP</b> 2 1 2 1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of mathematics, mechanics and thermo	dynamics		
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
Knowledge	Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired.			
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the context of the overall system.			
Personal Competence				
Social Competence	Students are made aware of interdisciplinary c	ommunication in groups.		
Autonomy	Students are able to independently analy implementation as well as to think system orien		cepts and	their technical
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	150 min			
-	General Engineering Science (German program): 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 (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory Logistics and Mobility: Specialisation Logistics and Mobility: Elective Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory			



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

Course L0742: Fundame	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	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	SoSe	
Content	<ol> <li>Air transport as part of the global transportation system</li> <li>Legal basis of air transportation</li> <li>Safety and security aspects</li> <li>Aircraft basics</li> <li>The role of the aircraft amnufacturer</li> <li>The role of the aircraft operator</li> <li>Airport operation</li> <li>The principles of air traffic management</li> <li>Environmental aspects of air transportation</li> <li>Future perspectives of air transport</li> </ol>	
Literature	<ol> <li>V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5</li> <li>H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003</li> <li>K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0</li> <li>I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5</li> <li>D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3</li> <li>N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4</li> <li>P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8</li> <li>H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0</li> </ol>	

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



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



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

Compulsory	1
General Engineering Science (English program, 7 semester): Specialisation Computer S	Science:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engin	neering:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Civil Engin	neering:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Energy and Envir Engineering: Compulsory	omental
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neerina.
Focus Mechatronics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engi	neering.
Focus Biomechanics: Compulsory	0,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering,
Focus Aircraft Systems Engineering: Compulsory	_
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin Focus Product Development and Production: Compulsory	neering,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neerina
Focus Energy Systems: Compulsory	looning,
Computational Science and Engineering: Core qualification: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Logistics and Mobility: Core qualification: Compulsory	
Mechanical Engineering: Core qualification: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Technomathematics: Core qualification: Compulsory	
Process Engineering: Core qualification: Compulsory	



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



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



## Focus Materials in Engineering Sciences

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

## Module M0597: Advanced Mechanical Engineering Design

Courses				
<b>Fitle</b>		Тур	Hrs/wk	СР
Advanced Mechanical Engir		Lecture	2	2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Advanced Mechanical Engir Advanced Mechanical Engir		Lecture Recitation Section (large)	2 2	2 1
_		recitation Section (large)	2	I
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanica</li> <li>Mechanics</li> <li>Fundamentals of Materials S</li> <li>Production Engineering</li> </ul>			
<b>Educational Objectives</b>	After taking part successfully, stude	nts have reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>After passing the module, students are able to:</li> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>transfer knowledge learned skills),</li> </ul>	alculations of covered machine element I in the module to new requirements nnical drawings and schematic sketche	and tasks (p	problem solvin
Personal Competence				
Social Competence	<ul> <li>Students are able to discumethods.</li> </ul>	uss technical information in the lectu	re supporte	d by activatin
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study	Time in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120			

## 

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



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



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



urse L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	
-	Advanced Mechanical Engineering Design I & II
Content	Lecture  • Fundamentals of the following machine elements:  • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics  Exercise  • Calculation methods of the following machine elements: • Linear rolling bearings • Calculation methods of the following machine elements: • Linear rolling bearings • Calculation methods of the following machine elements: • Calculation methods of the following machine element
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springe Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuell Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> </ul>



Course 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



<u> </u>				
Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (larg	3 e) 1	4 2
		ricolation coolion (larg	0, 1	-
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
Recommended	The modul is an introduction to the	ne theory of signals and systems.	Good knowled	ge in maths a
	covered by the moduls Mathematik	1-3 is expected. Further experience	e with spectral	
	(Fourier series, Fourier transform, La	aplace transform) is useful but not re	quired.	
Educational Objectives	After taking part successfully, studer	nts have reached the following learn	ing results	
Professional				
Competence				
		nd describe signals and linear time ory. They are able to apply the fu		
Knowledge		signals and systems. They can desc		
Knowledge		in both time and image domain. In		
	effects in time domain and image signal to a discrete-time signal.	domain which are caused by the t	transition of a	continuous-tir
		nd analyse deterministic signals an	d linear time-in	ivariant svster
	using methods of signal and syste	m theory. They can analyse and de	esign basic sys	stems regardi
OKIIIS		tude and phase response, stability,	-	hey can asse
Personal Competence	the impact of L H systems on the sig	nal properties in time and frequency	domain.	
-	The students can jointly solve speci	fic problems		
	The students can jointly solve specific problems. The students are able to acquire relevant information from appropriate literature sources. They ca			
Autonomy	control their level of knowledge du	ring the lecture period by solving tu		
	clicker system.			
	Independent Study Time 124, Study	r Time in Lecture 56		
Credit points				
Examination				
Examination duration and scale	90 min			
	General Engineering Science (Gerr	nan program): Specialisation Electric	cal Engineering	g: Compulsory
		nan program): Specialisation Compu		
	<b>U</b>	nan program): Specialisation Proces nan program): Specialisation Biopro	• •	• •
		(German program): Specialisation		
	Engeneering: Compulsory			
	General Engineering Science Compulsory	(German program): Specialisatio	on Mechanica	I Engineerir
		nan program): Specialisation Biome	dical Engineeri	ng: Compulso
		man program, 7 semester): Specia	lisation Electric	al Engineerin
	Compulsory General Engineering Science (Ge	erman program, 7 semester): Spec	rialisation Con	nnuter Scienc
	Compulsory			
		rman program, 7 semester): Specia	alisation Proce	ss Engineerin
	Compulsory General Engineering Science (Gerr	nan program, 7 semester): Specialis	ation Bioproce	ss Engineerin
	Compulsory			
		nan program, 7 semester): Specialis	ation Biomedic	cal Engineerin
	Compulsory General Engineering Science (Gerr	nan program 7 semester): Specialis	ation Mechanic	al Engineerir



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



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



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



Module M0988: Sti	ructural Materials			
Courses				
TitleTypFundamentals of Mechanical Properties of Materials (L1090)LectureWelding Technology (L1123)Lecture		Lecture	Hrs/wk 2 3	<b>CP</b> 3 3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Materials Science			
Educational Objectives	After taking part successfully, students have re	eached 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 mos important welding technologies and the corresponding systems. They learn about the influence of welding on the materials and design.			
Skills	The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding behaviour of steel materials. The students are able to select between alloys according to the desired mechaincal properties and welability. They can distinguish between different welding techniques and select the suitable technique and system components for a defined application. They are able to dimension weld joints within design tasks.			
Personal Competence				
Social Competence	none			
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory			



Course L1090: Fundame	Course L1090: Fundamentals of Mechanical Properties of Materials		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Norbert Huber, Dr. Erica Lilleodden		
Language	EN		
Cycle	SoSe		
Content	<ol> <li>Introduction and overview</li> <li>Bonding and crystallography, stress, strain, linear elasticity</li> <li>Plasticity of metallic materials</li> <li>Dislocations: Structure, stress, strain, strain energy</li> <li>Dislocations: Motion and forces</li> <li>Partial dislocations, dislocation interactions, jogs and kinks</li> <li>Strengthening mechanisms</li> <li>Introduction to modelling of materials behaviour, classification of</li> <li>phenomena</li> <li>Linear and nonlinear elasticity</li> <li>Plasticity, tensile loading, cyclic loading</li> <li>Viscoelasticity, effects of loading history, creep, relaxation</li> <li>Viscoplasticity, overstress, rate sensitivity of metallic materials</li> <li>Identification of material parameters</li> </ol>		
Literature	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)		



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



Courses				
Title		Twn	Hrs/wk	СР
Numerical Mathematics I (Li	0417)	<b>Typ</b> Lecture	<b>ПГS/WK</b> 2	3 3
Numerical Mathematics I (L		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Mathematik I + II for Engineering Stude II for Technomathematicians</li> <li>basic MATLAB knowledge</li> </ul>	ents (german or english) <b>or</b> A	nalysis & Lir	iear Algebra I
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional				
Competence	Students are able to			
Knowledge	<ul> <li>name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas,</li> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computations and storage complexitx.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numerical methods using MATLAB,</li> <li>justify the convergence behaviour of numerical methods with respect to the problem as solution algorithm,</li> <li>select and execute a suitable solution approach for a given problem.</li> </ul>			
Personal Competence	Chudanta ava akla ta			
Social Competence	<ul> <li>Students are able to</li> <li>work together in heterogeneously con and background knowledge), explair practical aspects regarding the implem</li> </ul>	n theoretical foundations an		• • •
Autonomy	<ul> <li>Students are capable</li> <li>to assess whether the supporting t individually or in a team,</li> <li>to assess their individual progess and,</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German progra General Engineering Science (German pro Biomechanics: Compulsory General Engineering Science (German pro Materials in Engineering Sciences: Compulso General Engineering Science (German progra General Engineering Science (German pro Compulsory General Engineering Science (German progra Focus Materials in Engineering Sciences: Cor	gram): Specialisation Mech gram): Specialisation Mech ry am): Specialisation Biomedica gram, 7 semester): Specialisatic	anical Engi anical Engi al Engineerin isation Com	neering, Foc neering, Foc ng:Compulso puter Scienc



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

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



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



Module M1009: Ma	terial Science Laboratory			
Courses				
Title Companion Lecture for Mate Material Science Laboratory	erials Science Laboratory (L1088) (L1235)	<b>Typ</b> Lecture Practical Course	<b>Hrs/wk</b> 2 4	<b>CP</b> 2 4
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students ha	ave 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 othe 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 lea	sson		
-	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: 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: Compani	on Lecture for Materials Science Laboratory
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Patrick Huber
Language	DE
Cycle	WiSe
Content	<ul> <li>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:</li> <li>1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids)</li> <li>2. notch impact test (elastic properties of solids)</li> <li>3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)</li> <li>4. tensile test (elastic properties of solids)</li> <li>5. Identificiation of polymers (polymer physics)</li> <li>6. fiber-reinforced polymers (physical principles of composite materials)</li> <li>7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)</li> <li>8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)</li> </ul>
Literature	<ul> <li>William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&amp;Sons, Asia (2011)</li> <li>William D. Callister, Materials Science and Technology, Wiley&amp; Sons, Inc. (2007)</li> </ul>

Тур	Practical Course
Hrs/wk	
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. Jör Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II



Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models 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 at frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tir and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems.			
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning proc			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (German p	program, 7 semester): Special	sation Con	

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



	•	fication: Comp cialisation III. E	,	Science: Elective	e Compul	lsory		
Theoretical	Mechanical	Engineering:	Technical	Complementary	Course	Core	Studies:	Elective
Compulsory								
Process Eng	ineering: Cor	re qualification	: Compulso	ry				

Course L0654: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         Principle of feedback, open-loop versus closed-loop control         Reference tracking and disturbance rejection         Types of feedback, PID control         System type and steady-state error, error constants         Internal model principle         Root locus techniques         Root locus design of PID controllers         Frequency response techniques         Nyquist plot, Nyquist stability criterion, phase and gain margin         Loop shaping, lead lag compensation         Frequency response interpretation of PID control         Time delay systems         Root locus and frequency response of time delay systems         Smith predictor         Digital control         Sampled-data systems, difference equations         Tustin approximation, digital implementation of PID controllers         Software tools         Introduction to Matlab, Simulink, Control toolbox         Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible				
A durie e ie u	None			
Requirements				
Recommended Previous Knowledge	<ul> <li>Basic knowledge in electrical engineering</li> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such th respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the arks are lifted	examination's
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
	<ul> <li>This module deals with the foundations of the fur from the assembly-level programming down to gate introduction</li> <li>Combinational logic: Gates, Boolean a combinational networks</li> <li>Sequential logic: Flip-flops, automata, syste</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subte</li> <li>Basics of computer architecture: Prograpipelining</li> <li>Memories: Memory hierarchies, SRAM, DF</li> <li>Input/output: I/O from the perspective of connections, busses</li> </ul> The students perceive computer systems from the structure and the physical composition of compute specific and individual computers can be built bathey are able to distinguish between and to computing systems - from gates and circuits up to a 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 gate impact that these low abstraction levels have o feasible options.	tes. The module includes algebra, Boolean funct ematic hardware design traction, multiplication and amming models, MIPS AAM, caches the CPU, principles of p architect's perspective, i ter systems. The studen used on a collection of fe explain the different ab complete processors. students are able to jun software executed on of software has on the h tes. This way, they will b	the following ions, hardw d division single-cycl bassing data .e., they iden ts can analy w and simpl ostraction lay dge the inte it. In particu ardware-cer be enabled	g topics: are synthesis e architecture , point-to-poin atify the interna ze, how highly e components yers of today's rdependencies ilar, they shal thric abstraction to evaluate the
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Examination	Written exam			
Examination duration	90 minutes, contents of course and labs			

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

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

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



Module M1005: En	hanced Fundamentals of Ma	aterials Science			
Courses					
Title		Тур	Hrs/wk	СР	
	eramics and Polymers (L1233)	Lecture	2	2	
Enhanced Fundamentals: C	eramics and Polymers (L1234)	Recitation Section (larg	e) 1	1	
Enhanced Fundamentals: M	letals (L1086)	Lecture	2	3	
	Prof. Gerold Schneider				
Admission Requirements	None				
	Module "Fundamentals of Materials Sc	ience"			
Pacommonded	Module "Materials Science Laboratory	1			
Previous Knowledge					
	Module "Advanced Materials"				
Educational Objectives	After taking part successfully, students	have reached the following learn	ing regulte		
Professional		nave reached the following learn	กาษ เองนแร		
Competence					
	The students are able to give an enhar	-	•		
	in metals, polymers and ceramics: Ato and mass transport, microstructure				
Knowledge	corresponding technical terms.	and phase diagrams. They			
Skills	The students are able to apply the mentioned subjects.	appropriate physical and cher	nical methods	for the above	
Oniiis	mentioned subjects.				
Personal Competence					
Social Competence					
	The students are capable to understan				
Autonomy	and polymers. They should be able to critally evaluate the profoundness of their knowledge.				
Workload in Hours	Independent Study Time 110, Study Ti	me in Lecture 70			
Credit points	6				
Examination	Written exam				
Examination duration and scale	180 min				
	General Engineering Science (Germ		echanical Eng	ineering, Focus	
	Materials in Engineering Sciences: Co General Engineering Science (German		ation Mechanic	cal Engineering	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,				
	Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus				
Assignment for the Following Curricula	Materials in Engineering Sciences: Co	mpulsory	_	-	
	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				
	Technomathematics: Opeclaisation in:		paioory		

Course L1233: Enhanced Fundamentals: Ceramics and Polymers



Hrsvik         2           Ord         2           Workod in Housen Independent Study Time 32, Study Time in Lecture 28           Lecturer         Frof. Geroid Schneider, Prof. Bodo Fiedler           Language         DEFN           Cycel         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Künstliche" Keramiken" - Vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverherstellung         Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur XICO-Herstellung Chemical Vapour Deposition           Pulveraubreitung         Mahltechnik Sprühtrockner           3. Formgebung         Arten der Formgebung (16 - 25 % Feuchte)           Palsein (- 15 % Feuchte) Gießen (- 25 % Feuchte)           Plastische Formgebung (16 - 25 % Feuchte)           Palsein (- 15 % Feuchte)           Gießen (- 25 % Feuchte)           Plastische Formgebung (16 - 25 % Feuchte)           Plastische Formgebung (16 - 25 % Feuchte)           Fraesen (0 - 15 % Feuchte)           Gießen (- 25 % Feuchte)           Plastische Formgebung (16 - 25 % Feuchte)           Plastische Formgebung (16 - 25 % Feuchte)           Fraesen (0 - 15 % Feuchte)           Gießen (-25 % Feuchte)           Plastische Formgebung (16 - 25 % Feuchte)           Frachykraft des Sinterns	Тур	Lecture
Workload In Hours         Independent Study Time 32, Study Time in Lecture 28           Lecturer         Prof. Carold Schneider, Prof. Bodo Fiedler           Languege         DE/EN           Cycle         SoSe           1. Einführung         Natifiche "Keramiken" - Steine "Künstliche" Keramik vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverherstellung         Einfeilung der Pulversyntheseverfahren Der Bayer-Prozess zur XICO-Herstellung           Der Bayer-Prozess zur XICO-Herstellung         Pulveraufbereitung           Mahltechnik         Sprühtrockner           3. Formgebung         Arten of Formgebung           Pressen (0 - 15 % Feuchte)         Gielen (> 25 % Feuchte)           Content         4. Sintern           Triebkräft des Sinterns         Effekt von gekrümmten Oberlächen und Diffusionswegen           Sinterstallen des isotterners         Feffekt von gekrümmten Oberlächen und Diffusionswegen           Sinterstallen des isotterners         Feffekt von gekrümmten Oberlächen und Diffusionswegen           Sinterstallen des isotterners         Feffekt von gekrümmten Oberlächen und Diffusionswegen           Sinterstallen des isotterners         Feffekt von gekrümmten Oberlächen und Diffusionswegen           Sinterstallen des isotterners         Feffekt von gekrümmten Oberlächen von Keramiken           Fersolykeit - Linzer-Jasische Bruchmechanik	Hrs/wk	2
Lecturer         Prof. Garold Schneider, Prof. Bodo Fiedler           Language         DEFN           Cycle         SoSe           1. Einführung           Natürliche ,Keramiken* - Steine           "Künstliche" Keramik           2. Pulverinerstellung           Einteilung der Pulversyntheseverfahren           Der Acheson-Prozesz urz (2024-Herstellung)           Der Acheson-Prozesz urz (2024-Herstellung)           Chemical Vapour Deposition           Pulveraufbereitung           Mahtlechnik           Sprühtrockner           3. Formgebung           Pressen (0 - 15 % Feuchte)           Gießen (- 25 % Feuchte)           Plastische Formgebung (15 - 25 % Feuchte)           Plastische Formgebung (15 - 25 % Feuchte)           Plastische Sinterns           Effekt von gekrümmten Oberlächen und Diffusionswegen           Sinterstadier des isothermen Fessphasensinterns           Herlißsostatisches Pressen           5. Mechanische Eigenschaften von Keramiken           Elastisches und plastisches Materialverhalten           Bruczhältigkeit - Linzer-leastische Bruchmechanik           Festigkeit- Festigkeitisstere           6. Elektrische Eigenschaften von Keramiken           Festigkeit- Festigkeitissteure           6. Elektrische Karamiken<	СР	2
Language         DE/EN           Cycle         SoSe           1. Einführung         Natürliche /Keramiken''-Steine           "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik         Anwendungen v           Jober Bayer-Prozess zur Sic-Herstellung         Einteilung der Pulversyntheseverfahren           Der Bayer-Prozess zur Sic-Herstellung         Der Acheson-Prozess zur Sic-Herstellung           Der Acheson-Prozess zur Sic-Herstellung         Der Acheson-Prozess zur Sic-Herstellung           Mahltechnik         Sprühtrockner         3. Formgebung           Arten der Formgebung         Prossen (0.15 % Feuchte)         Gießen (> 25 % Feuchte)           Onternt         4. Sintern         Triebkraft des Sinterns         Effekt von gekrümmten Oberflächen und Diffusionswegen           Sinterstadien des isothermen Festphasensinterns         Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken           Elastisches und plastisches Materialverhalten         Bruchzähigkeit - Linear-elastische Bruchmechanik         Festigkeit - Festigkeitsstreuung           6. Elektrische Eigenschaften von Keramiken         Feroelektische Keramiken         Feroelektische Katerniken           Piezo-, feroelektische Materialeigenschaften         Anwendungen         Anwendungen           Keramische Ionenleiter         Ionische Leitfähigkeit         Ionische Leitfähigkeit           Dot	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Oycle         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverherstellung         Einteilung der Pulversynthesevorfahren Der Bayer-Prozess zur AICO-Herstellung Der Acheson-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Ohermical Vapour Deposition           Pulveraufbereitung         Mahltechnik Sprührockner           3. Formgebung         Arten der Formgebung Presson (0 - 15 % Feuchte)           Gleßen (- 25 % Feuchte)         Plastische Formgebung (15 - 25 % Fouchte)           Content         4. Sintern           Triebkraft des Sinterns         Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isofhermen Festphasensinterns Herring scalling laws Heißisostatisches Pressen           5. Mechanische Eigenschaften von Keramiken         Einstisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung           6. Elektrische Eigenschaften von Keramiken         Feroelektrische Karamiken           Fiezo-, ferroelektrische Materialeigenschaften Anwendungen         Reramische Ionenleiter           Deinische Leitfähigkeit         Dotiernes Zirkonoxid in der Brennstoffzelle und Lambdasonde           D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier           D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 <th>Lecturer</th> <th>Prof. Gerold Schneider, Prof. Bodo Fiedler</th>	Lecturer	Prof. Gerold Schneider, Prof. Bodo Fiedler
1. Einführung         Natürliche "Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v         Hochleistungskeramik         2. Pulverherstellung         Einteilung der Pulversyntheseverfahren         Der Rayen-Prozess zur Al2O3-Herstellung         Der Acheson-Prozess zur SIC-Herstellung         Der Acheson-Prozess zur SIC-Herstellung         Mahltschnik         Sprührockner         3. Formgebung         Arten der Formgebung         Plastische Formgebung         Plastische Formgebung (15 - 25 % Feuchte)         Content         4. Sintern         Triebkrät des Sinterns         Effekt von gekrümmten Oberflächen und Diffusionswegen         Sinterstadien des isothermen Festphasensinterns         Herifigiscatalisches Pressen         5. Mechanische Eigenschaften von Keramiken         Elastisches und plastisches Materialverhalten         Bruchzähigkeit - Linear - elastische Bruchmechanik         Festigkeitsche Keramiken         Piezo, førreelektlische Materialeigenschaften		
Natürliche "Keramikker" - Steine "Künstliche" Keramikk - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik         2. Pulverherstellung         Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Chemical Vapour Deposition         Pulveraufbereitung         Mahltechnik Sprühtrockner         3. Formgebung         Anten 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 Hering sozialng laws Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Elsäsches und plastisches Materialverhalten Bruchzähigkei - Linear-Jealstsche Buchmechanik Festigkeit - Festigkeitstreuung         6. Elektrische Keramiken         Piezo-, ferroelektrische Materialeigenschaften Anwendungen         Keramische Loiffähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde         D R H Jones, Michael F. Ashty, Engineering Materials 1, An Introduction to Properties, Applicatid and Design, Elsesvier         D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	Cycle	
and Design, Elesevier D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	Content	Natürliche Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vor Hochleistungskeramik 2. Pulverherstellung Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur AI2O3-Herstellung Der Acheson-Prozess zur SIC-Herstellung Der Acheson-Prozess zur SIC-Herstellung Mahltechnik Sprühtrockner 3. Formgebung Arten der Formgebung Pressen (0 - 15 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte) 4. Sintern Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen 5. Mechanische Eigenschaften von Keramiken Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung 6. Elektrische Eigenschaften von Keramiken Ferroelektische Keramiken Piezo-, ferroelektrische Materialeigenschaften Anwendungen Keramische lonenleiter lonische Leiflähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
		and Design, Elesevier
		D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre		D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pres 1998
D. Munz, T. Fett, Ceramics, Springer, 2001		D. Munz T. Fett Caromical Springer 2001



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

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



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



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



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



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



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



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



## **Focus Mechatronics**

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

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engin		Lecture	2	2
Advanced Mechanical Engir Advanced Mechanical Engir		Recitation Section (large) Lecture	2 2	1 2
Advanced Mechanical Engir		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Competence	After passing the module, students are at	ble to:		
Knowledge	<ul> <li>explain complex working principles and functions of machine elements and of basic elements of fluidics,</li> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>			
Skills	<ul> <li>After passing the module, students are at</li> <li>accomplish dimensioning calcula</li> <li>transfer knowledge learned in th skills),</li> <li>recognize the content of technical</li> <li>evaluate complex designs, techni</li> </ul>	tions of covered machine element te module to new requirements a drawings and schematic sketches	and tasks (p	problem solvin
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss te methods.</li> </ul>	echnical information in the lectu	re supporte	d by activating
Autonomy	<ul> <li>Students are able to independent</li> <li>Students are able to acquire ac content e.g. by using the video red</li> </ul>	dditional knowledge and to reca	-	
	Independent Study Time 68, Study Time	in Lecture 112		
Credit points				
	Written exam			
Examination duration and scale	120			

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



	d 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	
Cycle	SoSe
Content	<ul> <li>Exercise</li> <li>Calculation methods of the following machine elements: <ul> <li>Linear rolling bearings</li> <li>Axes &amp; shafts</li> </ul> </li> </ul>
Literature	<ul> <li>Clutches &amp; brakes</li> <li>Belt &amp; chain drives</li> <li>Gear drives</li> <li>Epicyclic gears</li> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> </ul> Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, I Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.



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



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



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

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	Тур		Hrs/wk	СР
		Section (large)	-	4 2
•		(laige)	•	-
None				
Mathematics 1-3				
The modul is an introduction to the theory of signals and systems. Good knowledge in maths covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation				
After taking part successfully, stude	ents have reached the follo	wing learning	results	
-	-			-
-	e domain which are cause	ed by the trans	sition of a c	continuous-tin
	and analyzed deterministic	aionala and lin	a a r tima in	verient eveter
using methods of signal and system theory. They can analyse and design basic sys				
important properties such as magnitude and phase response, stability, linearity etc They can asses				
the impact of LTI systems on the sig	gnal properties in time and	frequency dor	nain.	
The students can jointly solve specific problems.				
clicker system.	5 1 3	0	,	
Independent Study Time 124, Stud	ly Time in Lecture 56			
6				
Written exam				
90 min				
	man program): Specialized	tion Floatriaal (	Enginooring	Compulsory
<b>u u v</b>			• •	
General Engineering Science (Gen	man program): Specialisat	tion Process E	ngineering:	Compulsory
	(German program): Sp	Declaiisation	Civil- and	Enviroment
	(German program): Sp	pecialisation	Mechanical	Engineerin
Compulsory				0
Compulsory				agco
	erman program, 7 seme	ster): Speciali	sation Com	puter Scienc
1 2	erman program. 7 semest	er): Specialisa	tion Proces	s Engineerin
Compulsory				-
	rman program, 7 semester	): Specialisatic	on Bioproces	ss Engineerin
	rman program 7 semester	): Specialisatio	n Biomedic	al Engineerin
Compulsory		, epseulouit		
	The modul is an introduction to a covered by the moduls Mathemati (Fourier series, Fourier transform, I After taking part successfully, stude The students are able to classify methods of signal and system th continuous-time and discrete-time signals and systems mathematical effects in time domain and image signal to a discrete-time signal. The students are able to describe using methods of signal and syste important properties such as mage the impact of LTI systems on the signal the students are able to acquire control their level of knowledge du clicker system. Independent Study Time 124, Stud 6 Written exam 90 min General Engineering Science (Gen General Engineering Science (Gen Compulsory General Engine	b)       Lecture Recitation S         Prof. Gerhard Bauch       None         Mathematics 1-3       The modul is an introduction to the theory of signals and covered by the moduls Mathematik 1-3 is expected. Further (Fourier series, Fourier transform, Laplace transform) is usefu         After taking part successfully, students have reached the follo         The students are able to classify and describe signals and methods of signal and system theory. They are able to a continuous-time and discrete-time signals and systems. The signals and systems mathematically in both time and image effects in time domain and image domain which are cause signal to a discrete-time signal.         The students are able to describe and analyse deterministic using methods of signal and system theory. They can analy important properties such as magnitude and phase response the impact of LTI systems on the signal properties in time and         The students can jointly solve specific problems.         The students are able to acquire relevant information from control their level of knowledge during the lecture period by clicker system.         Independent Study Time 124, Study Time in Lecture 56 6         Written exam         90 min         General Engineering Science (German program): Specialisat General Engineering Science (German program); Specialisat	)       Lecture Recitation Section (large)         Prof. Gerhard Bauch       None         Mathematics 1-3       The modul is an introduction to the theory of signals and systems. Goc covered by the moduls Mathematik 1-3 is expected. Further experience w (Fourier series, Fourier transform, Laplace transform) is useful but not requir         After taking part successfully, students have reached the following learning         The students are able to classify and describe signals and linear time-im methods of signal and system theory. They are able to apply the fund: continuous-time and discrete-time signals and systems. They can describe signals and systems mathematically in both time and image domain. In par effects in time domain and image domain which are caused by the tran- signal to a discrete-time signal.         The students are able to describe and analyse deterministic signals and signet to a discrete-time signal.         The students are able to describe and analyse deterministic signals and linear time-im methods of signal and system theory. They can analyse and desig important properties such as magnitude and phase response, stability, line the impact of LTI systems on the signal properties in time and frequency dor         The students can jointly solve specific problems.         The students are able to acquire relevant information from appropriate lift control their level of knowledge during the lecture period by solving tutora clicker system.         Independent Study Time 124, Study Time in Lecture 56         6	)       Leture       3         Prof. Gerhard Bauch       None         Mathematics 1-3       The modul is an introduction to the theory of signals and systems. Good knowledg covered by the moduls Mathematik 1-3 is expected. Further experience with spectral (Fourier series, Fourier transform, Laplace transform) is useful but not required.         After taking part successfully, students have reached the following learning results         The students are able to classify and describe signals and linear time-invariant (LTI) methods of signal and system theory. They are able to apply the fundamental transform and discrete-time signals and systems. They can describe and analys signals and 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 c signal to a discrete-time signal.         The students are able to describe and analyse deterministic signals and linear time-invariant (LTI) moporties yoneprites such as magnitude and phase response, stability, linearity etc The students are able to acquire relevant information from appropriate literature sou control their level of knowledge during the lecture period by solving tutorial problems, clicker system.         Independent Study Time 124, Study Time in Lecture 56       6         90 min       General Engineering Science (German program): Specialisation Forcess Engineering General Engineering Science (German program): Specialisation Dirocces Engineering General Engineering Science (German program): Specialisation Dirocces Engineering General Engineering Science (German program): Specialisation Biomedical Engineering General Engineering Science (German program): Specialisation Biomedical Engineering General



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



rse 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. Teubne Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>			

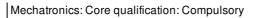


Course L0433: Signals a	ourse L0433: Signals and Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Gerhard Bauch		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking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

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Courses				
<b>Title</b> Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	chatronic Systems (L1823)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible	• • •		-	
A dmission	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory	and electrical engineering		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence <i>Knowledge</i>	Students are able to describe methods optimization of mechatronic systems.	and calculations for design,	modeling,	simulation a
Skills	I Students are able to apply modern algorithms for modeling of mechatronic systems. They can ident simulate and design simple systems and implement those in laboratory conditions.			
Personal Competence				
Social Competence				
Autonomy	Students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and define further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German p Mechatronics: Compulsory General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German prog Focus Mechatronics: Compulsory General Engineering Science (German prog Focus Mechatronics: Compulsory General Engineering Science (German prog Focus Aircraft Systems Engineering: Compu General Engineering Science (German prog Focus Theoretical Mechanical Engineering: General Engineering Science (German prog Focus Theoretical Mechanical Engineering: General Engineering Science (English p Aircraft Systems Engineering: Compulsory General Engineering Science (English p Mechatronics: Compulsory General Engineering Science (English prog Focus Mechatronics: Compulsory General Engineering Science (English prog Focus Mechatronics: Compulsory General Engineering Science (English prog Focus Aircraft Systems Engineering: Compu General Engineering Science (English prog Focus Theoretical Mechanical Engineering: Mechanical Engineering: Specialisation Airc	rogram): Specialisation Mech rogram): Specialisation Mech ulsory gram, 7 semester): Specialisation gram, 7 semester): Specialisation lsory gram, 7 semester): Specialisation Elective Compulsory rogram): Specialisation Mech rogram): Specialisation Mech ulsory gram, 7 semester): Specialisation gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation gram, 7 semester): Specialisation Elective Compulsory gram, 7 semester): Specialisation Elective Compulsory gram, 7 semester): Specialisation compulsory gram, 7 semester): Specialisation compulsory gram, 7 semester): Specialisation compulsory graft Systems Engineering: Compulsory	anical Engi anical Engi on Mechanic on Mechanic on Mechanic anical Engi anical Engi on Mechanic on Mechanic on Mechanic	neering, Foc neering, Foc al Engineerir al Engineerir al Engineerir neering, Foc neering, Foc al Engineerir al Engineerir al Engineerir



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

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

Course L1824: Simulation	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				
		<b>T</b>		0.0
<b>Title</b> Circuit Theory (L0566)		<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 4
Circuit Theory (L0566) Circuit Theory (L0567)		Recitation Section (small)	2	4
Module Responsible	Drof Arno Josep		-	_
-				
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics	and II		
Educational Objectives	After taking part successfully, students have	reached 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 frequency behaviour and the synthesis of passive two-terminal-circuits.			
Skills	The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits.			
Personal Competence				
Social Competence	Students work on exercise tasks in small gu their results within the group.	ided groups. They are encoura	iged to pres	ent and discu
Autonomy	The students are able to find out the required methods for solving the given practice problems Possibilities are given to test their knowledge during the lectures continuously by means of short-tim tests. This allows them to control independently their educational objectives. They can link their gaine knowledge to other courses like Electrical Engineering I and Mathematics I.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	i			
Examination				
Examination duration and scale				
	General Engineering Science (German prog General Engineering Science (German prog Mechatronics: Compulsory General Engineering Science (German prog Focus Mechatronics: Compulsory General Engineering Science (German pro Compulsory Electrical Engineering: Core qualification: Co	rogram): Specialisation Mech ram, 7 semester): Specialisatic gram, 7 semester): Specialisa	anical Engi on Mechanic tion Electric	neering, Foc al Engineerin al Engineerin



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

Course L0566: Circuit T	heory			
Тур	Lecture			
Hrs/wk	3			
СР				
Workload in Hours	dependent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Arne Jacob			
Language	DE			
Cycle	WiSe			
Content	<ul> <li>Circuit theorems</li> <li>N-port circuits</li> <li>Periodic excitation of linear circuits</li> <li>Transient analysis in time domain</li> <li>Transient analysis in frequency domain; Laplace Transform</li> <li>Frequency behaviour of passive one-ports</li> </ul>			
Literature	<ul> <li>M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)</li> <li>M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)</li> <li>L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)</li> <li>T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)</li> <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> <li>L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)</li> </ul>			

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



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission	None			
Requirements				
Recommended Previous Knowledge				examination's
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence	This module deals with the foundations of the fur	actionality of computing a	vetome It co	vore the lavor
Knowledge Skills	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software 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			
Personal Competence	feasible options.			
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from with other classes.	n specific literature and t	o associate t	his knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

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

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

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



Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
-			2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to	jointly solve technical problems, a	and experim	entally validat
Autonomy	Their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German General Engineering Science (Germa Compulsory General Engineering Science (German	n program, 7 semester): Special	isation Con	

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

Course L0654: Introduct	ion to Control Systems		
Тур	Lecture		
Hrs/wk	2		
СР	4		
Workload in Hours	ndependent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	)E		
Cycle	WiSe		
Content	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         Principle of feedback, open-loop versus closed-loop control         Reference tracking and disturbance rejection         Types of feedback, PID control         System type and steady-state error, error constants         Internal model principle         Root locus techniques         Root locus design of PID controllers         Frequency response techniques         Nont locus stability criterion, phase and gain margin         Loop shaping, lead lag compensation         Frequency response interpretation of PID control         Time delay systems         Root locus and frequency response of time delay systems         Smith predictor         Digital control         Sampled-data systems, difference equations         Tustin approximation, digital implementation of PID controllers         Software tools         Introduction to Matlab, Simulink, Control toolbox         Computer-based exercises throughout the course		
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>		



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



Courses				
<b>Title</b> Semiconductor Circuit Desig Semiconductor Circuit Desig		<b>Typ</b> Lecture Recitation Section (smal	<b>Hrs/wk</b> 3	<b>CP</b> 4 2
Module Responsible		, , , , , , , , , , , , , , , , , , ,	,	
A duoio o io u				
Recommended Previous Knowledge		ing		
Educational Objectives	After taking part successfully, studen	ts have reached the following learning	ng results	
Professional Competence			-	
Knowledge	<ul> <li>Students are able to explain the functionality of different MOS devices in electronic circuits.</li> <li>Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages.</li> <li>Students have solid knowledge about memory circuits and can explain their functionality and specifications.</li> <li>Students are able to explain how analog circuits functions and where they are applied.</li> <li>Students know the appropriate fields for the use of bipolar transistors.</li> </ul>			
Skills	<ul> <li>Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits.</li> <li>Students are able to develop different logic circuits and can design different types of logi circuits.</li> <li>Students can use MOS devices, operational amplifiers and bipolar transistors for specifi applications.</li> </ul>			
Personal Competence				
Social Competence		ently in heterogeneous teams. in small groups can solve probler	ns and answ	er professiona
Autonomy	<ul> <li>Students are able to assess t</li> </ul>	heir level of knowledge.		
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (Germ General Engineering Science (Ge Mechatronics: Compulsory General Engineering Science (Gerr Compulsory General Engineering Science (Germ Focus Mechatronics: Compulsory	rman program): Specialisation Me nan program, 7 semester): Speciali	chanical Eng	ineering, Focu cal Engineering



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

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



Tvn	Recitation Section (small)			
Hrs/wk				
CP				
	 Independent Study Time 46, Study Time in Lecture 14			
	Prof. Matthias Kuhl			
Language	DE			
Cycle				
Content	<ul> <li>Basic circuits with MOS transistors for logic gates and amplifiers</li> <li>Typical applications for analog and digital circuits</li> <li>Realization of logical functions</li> <li>Memory circuits</li> <li>Scaling-down of CMOS circuits and further perfomance improvements</li> <li>Operational amplifiers and their applications</li> <li>Basic circuits with bipolar transistors</li> <li>Design of exemplary circuits</li> <li>Electrical behavoir of BiCMOS circuits</li> </ul>			
Literature	<ul> <li>R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley &amp; Sons Inc., 3. Auflage, 2011 ISBN: 047170055S</li> <li>HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik un Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674</li> <li>K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944</li> <li>U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496</li> <li>H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berli 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>			

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



-	Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanica
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
Assignment for the	
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r onorning our nould	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	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
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	Naval Architecture: Core qualification: Compulsory
	Naval Architecture: Core qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective



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

Course L1044: Differential Equations 2 (Partial Differential Equations)		
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		

urse L1045: Differential Equations 2 (Partial Differential Equations)		
Recitation Section (large)		
1		
1		
Independent Study Time 16, Study Time in Lecture 14		
Dozenten des Fachbereiches Mathematik der UHH		
DE		
SoSe		
See interlocking course		
See interlocking course		
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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	SoSe		
Content	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>		
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>		

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

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



Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management	(1.0880)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Project Entrepreneurship (L		Project-/problem-based Learning	2	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busi	ness		
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most importar aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, informatio management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under rise</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the team themselves</li> <li>to write a report on their project.</li> </ul>			
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70		
Credit points				
-	Subject theoretical and practical work			
Examination duration	several written exams during the semester			



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and scale	General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program): Specialisation Computer Science: Compulsory
	General Engineering Science (German program): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental
	Engineering: Compulsory
	General Engineering Science (German program): Specialisation Civil- and Enviromental
	Engeneering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering:
	Compulsory
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
Assignment for the	
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 Electrical Engineering, Computerly General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Constant Engineering, Science (English program, 7 semester): Specialisation, Naval Architecture:
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
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Compulsory	
General Engineering Science (English program, 7 seme	ester): Specialisation Computer Science:
Compulsory	
General Engineering Science (English program, 7 semeste Compulsory	r): Specialisation Bioprocess Engineering:
General Engineering Science (English program, 7 sem Compulsory	ester): Specialisation Civil Engineering:
General Engineering Science (English program, 7 semester Engineering: Compulsory	): Specialisation Energy and Enviromental
General Engineering Science (English program, 7 semester Focus Mechatronics: Compulsory	r): Specialisation Mechanical Engineering,
General Engineering Science (English program, 7 semester Focus Biomechanics: Compulsory	r): Specialisation Mechanical Engineering,
General Engineering Science (English program, 7 semester Focus Aircraft Systems Engineering: Compulsory	r): Specialisation Mechanical Engineering,
General Engineering Science (English program, 7 semester Focus Materials in Engineering Sciences: Compulsory	r): Specialisation Mechanical Engineering,
General Engineering Science (English program, 7 semester Focus Theoretical Mechanical Engineering: Compulsory	r): Specialisation Mechanical Engineering,
General Engineering Science (English program, 7 semester Focus Product Development and Production: Compulsory	r): Specialisation Mechanical Engineering,
General Engineering Science (English program, 7 semester Focus Energy Systems: Compulsory	r): Specialisation Mechanical Engineering,
Computational Science and Engineering: Core qualification	: Compulsory
Computational Science and Engineering: Core qualification	
Logistics and Mobility: Core qualification: Compulsory	
Mechanical Engineering: Core qualification: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Technomathematics: Core qualification: Compulsory	
Process Engineering: Core qualification: Compulsory	



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



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



## **Focus Product Development and Production**

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

Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Engir			Lecture	2	2
Advanced Mechanical Engir			Recitation Section (large)	2 2	1
Advanced Mechanical Engir Advanced Mechanical Engir			Lecture Recitation Section (large)	2	2 1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part succes	lly, students have re	ached the following learning	results	
Professional Competence					
Knowledge	<ul> <li>explain requirements, selection criteria, application scenarios and practical examples complex machine elements,</li> <li>indicate the background of dimensioning calculations.</li> </ul>				
Skills	<ul> <li>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solvin skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>				
Personal Competence					
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activati methods.</li> </ul>				
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understoo content e.g. by using the video recordings of the lectures.</li> </ul>				
Workload in Hours	Independent Study Time	8, Study Time in Leo	cture 112		
Credit points	6				
Examination	Written exam				
Examination duration	120				



and scale	
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Energy Systems: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Mechatronics: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus
	Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
Assignment for the	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus
-	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
	Hava Alonicolulo. Oolo qualification. Oolipuisory



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



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



	d Mechanical Engineering Design I
	Lecture
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
Content	Advanced Mechanical Engineering Design I & II  Lecture
Literature	<ul> <li>Crank gears</li> <li>Sliding bearings</li> <li>Calculations of hydrostatic systems (fluidics)</li> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springe Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, 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., Spring Vieweg, aktuelle Auflage.</li> </ul>



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

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Courses				
Title Production Engineering I (L0608) Production Engineering I (L0612) Production Engineering II (L0610)		<b>Typ</b> Lecture Recitation Section (large) Lecture	<b>Hrs/wk</b> 2 1 2	<b>CP</b> 2 1 2
Production Engineering II (L		Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous Knowledge	no course assessments required internship recommended			
Educational Objectives	After taking part successfully, students have	e 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> <li>name boundaries, advantages and disadvantages of the different manufacturing process.</li> <li>describe elements, geometric properties and kinematic variables and requirements for tools workpiece and process.</li> <li>explain the essential models of manufacturing technology.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>select manufacturing processes in a</li> <li>design manufacturing processes component to be produced.</li> <li>assess components in terms of thei</li> </ul>	for simple tasks to meet the	required to	lerances of th
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>develop solutions in a production environment with qualified personnel at technical level and represent decisions.</li> </ul>			
Autonomy	<ul> <li>Students are able to</li> <li>interpret independently the manufacturing process.</li> <li>assess own strengths and weaknesses in general.</li> <li>assess their learning progress and define gaps to be improved.</li> <li>assess possible consequences of their actions.</li> </ul>			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	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 Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory
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Course L0608: Productio	on Engineering I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Manufacturing Accuracy</li> <li>Manufacturing Metrology</li> <li>Measurement Errors and Uncertainties</li> <li>Introduction to Forming</li> <li>Massiv forming and Sheet Metal Forming</li> <li>Introduction to Machining Technology</li> <li>Geometrically defined machining (Turning, milling, drilling, broaching, planning)</li> </ul>
Literature	<ul> <li>Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;)</li> <li>Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007</li> <li>Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004</li> <li>Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008</li> <li>Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008</li> <li>Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)</li> <li>Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006</li> <li>Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996</li> <li>Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)</li> </ul>

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



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

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



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



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

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



Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Machine Tools (L0689)		Lecture	2	2
Fundamentals of Machine Tools (L1992)		Recitation Section (large)	1	1
Forming and Cutting Techno	blogy (L0613)	Lecture	2	2
Forming and Cutting Techno	blogy (L0614)	Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
	without major course assessment			
Recommended	internship recommended			
Previous Knowledge				
	Previous knowledge in mathematics, me	echanics and electrical engineering	I	
Educational Objectives	After taking part successfully, students h	ave reached the following learning	results	
Professional				
Competence				
	Students are able to			
	<ul> <li>explain the basics of chip format</li> </ul>	on and mechanisms and models o	f machining.	
		ers for design and analysis of	-	
	processes and tools.			
Knowledge		nachine tool building and give an	overview o	on trends in th
	machine tool industry.			
	<ul> <li>explain types, constructions and</li> </ul>	I functions of CNC-machines and	give an ove	erview on mult
	machine systems.			
	<ul> <li>explain equipment components.</li> </ul>			
	Students are able to			
	<ul> <li>select tool geometry, cutting</li> </ul>	materials, process parameters a	nd appropr	iate measuring
	technique in accordance with the	e requirements.		
Skills	5 1 5 1			
	select appropriate machine tools for machining and create NC programs for turning and			
	milling.	and to detect weak points		
	<ul> <li>assess the quality of a machine to a machine</li></ul>	ools and to detect weak points.		
Personal Competence				
	Students are able to			
		n environment with qualified perso	onnel at tecl	nnical level and
Social Competence	represent decisions.			
	Students are able to			
		r000000		
	interpret independently cutting processes.     create independently NC programs			
Autonomy	<ul> <li>create independently NC programs.</li> <li>select independently machine tools by reference to appropriate requirements.</li> </ul>			
rateriony	<ul> <li>assess own strengths and weaknesses in general.</li> </ul>			
	<ul> <li>assess their learning progress a</li> </ul>	-		
	<ul> <li>assess possible consequences of</li> </ul>	of their actions.		
Workload in Hours	I Independent Study Time 96, Study Time	in Lecture 84		
Credit points				
Examination	Written exam			
Examination duration				
and scale	190 min			



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



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

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

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

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	mputer Engineering				
Courses					
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2	
Module Responsible					
A dunia nin u	None				
Requirements					
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results		
Professional					
Competence	This module deals with the foundations of the fun	ctionality of computing a	vetome It co	vore the lave	
Knowledge	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesic combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul>				
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the intern structure and the physical composition of computer systems. The students can analyze, how hig specific and individual computers can be built based on a collection of few and simple componer They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they sh 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 propor feasible options.				
Personal Competence					
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the resul	ts accordingly	
	Students are able to acquire new knowledge fron with other classes.	n specific literature and t	o associate	this knowledg	
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56			
Credit points					
Examination	Written exam				
Examination duration and scale	90 minutes, contents of course and labs				

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



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

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

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



Courses				
Title Introduction to Control Syste Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible				
Admission				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems	in time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence				
Knowledge	• They can explain the role of the	rst and second order systems s of simple control loops and inter d root locus ability criterion and the stability marg phase margin in analysis and synth ID controller affects a control loop	rpret dynam gins derived esis of contr p in terms o	ic properties i from it. rol loops of its frequenc
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to	jointly solve technical problems, a	and experim	entally validate
Autonomy	their controller designs Students can obtain information from experiment guides) and use it when sol- They can assess their knowledge in we	ving given problems.		
Workload in House	Independent Study Time 124, Study Tim	a in Lecture 56		
Credit points				
-	Written exam			
Examination duration and scale				
	General Engineering Science (German General Engineering Science (Germa Compulsory General Engineering Science (German	in program, 7 semester): Special	isation Com	

	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and
	Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory
Assignment for the	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
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
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	•	fication: Comp cialisation III. E	,	Science: Elective	e Compul	lsory		
Theoretical	Mechanical	Engineering:	Technical	Complementary	Course	Core	Studies:	Elective
Compulsory								
Process Eng	ineering: Cor	re qualification	: Compulso	ry				

Course L0654: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems  Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Module M0599: Int	egrated Product Development and	d Lightweight Desigi	n	
Courses				
Title		Тур	Hrs/wk	СР
CAE-Team Project (L0271)		Project-/problem-based	2	2
Development of Lightweight	Design Products (1.0270)	Learning Lecture	2	2
Integrated Product Develop	-	Lecture	2	2
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
	Advanced Knowledge about engineering desi	gn:		
	Fundamentals of Mechanical Engineering Des	sign		
Recommended Previous Knowledge	Mechanical Engineering: Design			
	Advanced Mechanical Engineering Design			
	After taking part successfully, students have re	ached the following learning	g results	
Professional Competence				
Compotenee	After completing the module, students are capa	able of:		
Knowledge	<ul> <li>explaining the functional principle of 3I</li> </ul>	CAD-Systems PDM- and I	FFM-System	s
nilowiedge	<ul> <li>describing the interaction of the different</li> </ul>	-	-	
Skills	<ul> <li>After completing the module, students are able to:</li> <li>evaluate different CAD- and PDM-Systems with regards to the desired requirements such 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	e to:		
Social Competence	<ul> <li>To develop a project plan and allocate work appropriate work packages in the framework o 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</li> </ul>	d complete a given practical	task with it	
Workload in Hours	Independent Study Time 96, Study Time in Lea	cture 84		
Credit points				
Examination	Written exam			
Examination duration and scale	90			
	General Engineering Science (German pro- Aircraft Systems Engineering: Compulsory General Engineering Science (German pro- Product Development and Production: Compu General Engineering Science (German progra Focus Aircraft Systems Engineering: Compulso General Engineering Science (German progra Focus Product Development and Production: C	gram): Specialisation Mech Isory am, 7 semester): Specialisati ory am, 7 semester): Specialisati	nanical Engi on Mechanic	neering, Focus



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

Course L0271: CAE-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	
Content	<ul> <li>Practical Introduction in the used software systems (Creo, Windchill, Hyperworks)</li> <li>Team formation, allocation of tasks and generation of a project plan</li> <li>Collective creation of one product out of CAD models supported by FEM calculations and PDM system</li> <li>Manufacturing of selected parts using 3D printer</li> <li>Presentation of results</li> </ul> <b>Description</b> Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation.	
Literature	-	



Course L0270: 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: Integrated 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 M1005: En	hanced Fundamentals of Mate	erials Science		
Courses				
Title		Тур	Hrs/wk	СР
	eramics and Polymers (L1233)	Lecture	2	2
	eramics and Polymers (L1234)	Recitation Section (large)	1	1
Enhanced Fundamentals: M	etals (L1086)	Lecture	2	3
	Prof. Gerold Schneider			
Admission Requirements	None			
	Module "Fundamentals of Materials Scien	nce"		
Recommended Previous Knowledge	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
Educational Objectives	After taking part successfully, students ha	we reached the following learning	results	
Professional				
Competence		ad a consistence according to a	~~	
Knowledge	The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects, electrica and mass transport, microstructure and phase diagrams. They are capable to explain the corresponding technical terms.			
	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	e in Lecture 70		
Credit points				
	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering 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 Technomathematics: Core qualification: Elective Compulsory			

## Course L1233: Enhanced Fundamentals: Ceramics and Polymers



1998	CP       2         rkload in Hours       Independent Study Time 32, Study Time in Lecture 28         Lecturer       Prof. Gerold Schneider, Prof. Bodo Fiedler         Language       DE/EN         Cycle       SoSe         1. Einführung       Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwende Hochleistungskeramik         2. Pulverherstellung	ungen vo	
Workload in Hours         Independent Study Time 32, Study Time in Lecture 28           Lecture         Prof. Geneld Schneider, Prof. Bodo Fiedler           Language         DE/EN           Cycle         SoSe           1. Eintöhrung         Natürliche "Keramiken" - Steine "Künstliche" Keramik vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverhestellung         Einteilung der Pulversynbeasverlahren Der Bayer Prozes zur AI2O3 Herstellung Der Acheson-Prozes zur AI2O3 Herstellung Der Acheson-Prozes zur SIC-Herstellung Der Acheson-Prozes zur SIC-Herstellung Der Sayer Prozes zur SIC-Herstellung Pulveraufbereilung           Mahltechnik Sprühtrockner         3. Formgebung Arten der Formgebung Pressen (0 - 15 % Feuchte) Plaslische Formgebung (15 - 25 % Feuchte) Plaslische Eigenschaften von Keramiken Effekt von gekümmten Oberflächen und Diffusionswegen Sinterstadien des istofhermen Festphasensinterns Herring scaling laws Heißiscatäsches Pressen           5. Mechanische Eigenschaften von Keramiken Eisstisches und plastisches Meterialverhalten Druchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung         Eisetrische Sintermiken Festigkeit Bayer von Keramiken           Ferroelektrische Materialeigenschaften Anwendungen         Piezo-, ferroelektrische Materialeigenschaften Anwendungen         Die Hones, Michael F. Ashty, Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier           D.W. Richerson. Michael F. Ashty, Engineering Materials 1, An Intr	rkload in Hours Independent Study Time 32, Study Time in Lecture 28          Lecturer       Prof. Gerold Schneider, Prof. Bodo Fiedler         Language       DE/EN         Cycle       SoSe         1. Einführung       Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwende Hochleistungskeramik         2. Pulverherstellung	ungen vo	
Lecturer         Prof. Gerold Schneider, Prof. Bado Fiedler           Language         DE/EN           Cycle         SoSe           1. Einführung         Natürliche "Keramiken" - Steine "Künstiche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pu/verherstellung         Einteilung der Pu/versyntheseverfahren Der Bayer Porzess zur AlCO-Herstellung Der Acheson-Prozess zur SIC-Herstellung           Der Bayer Porzess zur AlCO-Herstellung         Onemical Vapour Deposition           Pu/veraufbereilung         Mahticchnik           Sprühtrockner         3. Formgebung           Arten der Formgebung         Pressen (0.15 % Feuchte)           Gießen (> 25 % Feuchte)         Bisterstädlich des isotherem Festphasensinterns           Helfkisotalisches Pressen         5. Mechanische Eigenschaften von Keramiken           Elstisches und plastisches Materialverhalten         Bruchzähligkeit - Linear-elastische Bruchmechanik           Festigkeit - Linear-elastische Bruchmechanik         Festigkeit - Seitykoliststreuung           6. Elektrische Eigenschaften von Keramiken         Feroelektrische Karamiken           Piezo-, ferroelektrische Materialeigenschaften         Anwendungen           Keramische Ionenleiter         Onische Lottähligkeit           Onsiehe Lottähligkeit         Delsevier           D.W. Richerson, Modern Geramic Engineering Materials 1, An Introducti	Lecturer       Prof. Gerold Schneider, Prof. Bodo Fiedler         Language       DE/EN         Cycle       SoSe         1. Einführung         Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwende Hochleistungskeramik         2. Pulverherstellung	ungen vo	
Language         DE/EN           Cycle         SoSe         1. Einführung           Natürliche "Karamikan" - Steine Könstliche" Keramik         2. Pulverinstellung           2. Pulverinstellung         Einfeilung der Pulversyntheseverlahren Der Bayer-Prozess zur AI203-Herstellung           Der Acheson-Prozes zur SIG-Herstellung         Chemical Vapour Deposition           Pulveraufbereitung         Mahtischnik           Sprühtrockner         3. Formgebung           Arten der Formgebung         Prozesszur SIG-Herstellung           Mahtischnik         Sprühtrockner           3. Formgebung         Prosesen (0. 15 % Ereuchte)           Plastische Formgebung         Prosesen (0. 15 % Feuchte)           Plastische Formgebung (15 - 25 % Feuchte)         Plastische Formgebung (15 - 25 % Feuchte)           Content         4. Sintern         Triebkraft des Sinterns           Effekt von gekrümmten Oberflächen und Diffusionswegen         Sinterstadien des isothermen Festphasensinterns           Herfüg sozialing laws         Heißisostalisches Bruchten Non Keramiken           Elstsisches und plastisches Materialiverhalten         Runchraitsche Eigenschaften von Keramiken           Elstische Eigenschaften von Keramiken         Forroelektische Karamikan           Piezo , terroelektische Materialeigenschaften         Anwendungen           Keramische lonenteiler	Language       DE/EN         Cycle       SoSe         1. Einführung       Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwende Hochleistungskeramik         2. Pulverherstellung	Jngen vo	
Cycle         SoSe           1. Einführung         Natürliche "Keraniken" - Steine "Künstliche", Keraniken" - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik           2. Pulverhersteilung         Einteilung der Pulversynthesverfahren Der Bayer-Prozes zur AI203-Horsteillung Der Acheson-Prozess zur SIC-Hersteillung Ochemical Vapour Deposition           Pulveraufbereitung         Mahltechnik Sprühtrockner           3. Formgebung         Arten der Formgebung Pressen (0 - 15 % Feuchte)           Glaßen (> 25 % Feuchte)         Glaßen (> 25 % Feuchte)           Plastische Formgebung (15 - 25 % Feuchte)         Poletramin (15 - 25 % Feuchte)           Ottentt         4. Sintern           Trobbrait das Sintens         Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Fesiphasensinterns Herring scaling laws           Heißkösdlauches Pressen         5. Mechanische Eigenschaften von Keramiken           Eistliches und plastisches Materialiverhalten Bructzähigkeit - Linear-elastsche Bruchmechanik Fesigkeit - Fesigheitssteruung           6. Elektrische Eigenschaften von Keramiken           Feroelektische Karamiken           Piezo-, keroolektrische Materialeigenschaften Anwendungen           Koramische Ionenleiter           Dotiertes Zirkonoxid in der Brennstolfzelle und Lambdasonde           D H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier	Cycle       SoSe         1. Einführung         Natürliche "Keramiken" - Steine         "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwende         Hochleistungskeramik         2. Pulverherstellung	ungen vo	
<ol> <li>Eintlährung</li> <li>Natürliche, Keramiken* - Steine "Künstliche* Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik</li> <li>Pulverkeramik</li> <li>Pulversyntheseverfahren Der Bayer-Prozess zur AECO-Herstellung Der Acheson-Prozess zur SicO-Herstellung</li> <li>Chemical Vapour Deposition</li> <li>Pulveraufbereitung</li> <li>Mahtechnik</li> <li>Sprüfhrockner</li> <li>Formgebung</li> <li>Arten der Formgebung (15 - 25 % Feuchte)</li> <li>Content</li> <li>Sindern</li> <li>Triebkraft des Sinterns</li> <li>Effekt von gekrümmten Oberflächen und Diffusionswegen</li> <li>Sinterns</li> <li>Triebkraft des Sinterns</li> <li>Effekt von gekrümmten Oberflächen und Diffusionswegen</li> <li>Sinterstadien des isothermen Festphasensinterns</li> <li>Herling stätisches Pressen</li> <li>Mechanische Eigenschaften von Keramiken</li> <li>Elastisches und plastisches Materialverhalten</li> <li>Bruchzähigkeit - Linear-elastische Bruchmechanik</li> <li>Festigkeit - Ersteratelische Bruchten on Keramiken</li> <li>Elektrische Eigenschaften von Keramiken</li> <li>Elektrische Eigenschaften von Keramiken</li> <li>Ferroelektrische Keramikan</li> <li>Piezo-, feroelektrische Materialverhalten</li> <li>Anwendungen</li> <li>Keramische Ionenleiter</li> <li>Ionische Leittähigkeit</li> <li>Dotertes Zirkonoxid in der Brennstoffzeile und Lambdasonde</li> <li>D. M. Flicherson, Modern Ceramic Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier</li> <li>D. W. Richerson, Modern Ceramic Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier</li> <li>D. W. Richerson, Modern Ceramic Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier</li> <li>D. W. Richerson, Modern Ceramic Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier</li> <l< th=""><th>1. Einführung Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendu Hochleistungskeramik 2. Pulverherstellung</th><th>ungen vo</th></l<></ol>	1. Einführung Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendu Hochleistungskeramik 2. Pulverherstellung	ungen vo	
Natürliche, Yeramiken* - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen v Hochleistungskeramik         2. Pulverherstellung         Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur AI2C03-Herstellung         Der Acheson-Prozes zur SIC-Herstellung         Chemical Vapour Deposition         Pulveraufbereitung         Mahiltechnik         Sprühtrockner         3. Formgebung         Arten der Forngebung Pressen (0 - 15 % Feuchle)         Basische Formgebung (15 - 25 % Feuchle)         Plastische Formgebung (15 - 25 % Feuchle)         Reitvong gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen         5. Mechanische Eigenschaften von Keramiken         Eistylicht - Linzer-distische Bruchmechanik Festigkeit - Festigkeilsstreuung         6. Elektrische Keramiken         Piezo-, feroelektische Materialeigenschaften Anwendungen         Keramische lonenleiter         Ionische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde         D. H. Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applicatio and Design, Elesevier         D.W. Richerson, Modern Ceramic Engineering	Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwende Hochleistungskeramik 2. Pulverherstellung	ungen vo	
D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pres 1998	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)         Venter         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         Price2-, ferroelektrische Materialeigenschaften         Anwendungen         Keramische Ionenleiter         Ionische Leitfähigkeit         Ionische Leitfähigkeit	Applicatio	
W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pres 1998	and Design, Elesevier	and Design, Elesevier	
D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Pre- 1998	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992	
1998			
		D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998	
D. Munz, T. Fett, Ceramics, Springer, 2001	D Munz T Fott Coromics Springer 2001		



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

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



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



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



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

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



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



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



## **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: Ad	Ivanced Mechanical Engine	ering Design		
Courses				
<b>Title</b> Advanced Mechanical Engir Advanced Mechanical Engir Advanced Mechanical Engir Advanced Mechanical Engir	neering Design II (L0265) neering Design I (L0262)	<b>Typ</b> Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 2 2 2	<b>CP</b> 2 1 2 1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Fundamentals of Mechanical I</li> <li>Mechanics</li> <li>Fundamentals of Materials Sci</li> <li>Production Engineering</li> </ul>			
Educational Objectives	After taking part successfully, students	s 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>After passing the module, students are able to:</li> <li>accomplish dimensioning calculations of covered machine elements,</li> <li>transfer knowledge learned in the module to new requirements and tasks (problem solving skills),</li> <li>recognize the content of technical drawings and schematic sketches,</li> <li>evaluate complex designs, technically.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to discuss technical information in the lecture supported by activating methods.</li> </ul>			
Autonomy	<ul> <li>Students are able to independently deepen their acquired knowledge in exercises.</li> <li>Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Tir	me in Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	100			

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



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



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



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



Course 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	gnals and Systems			
<b>Fitle</b> Signals and Systems (L043 Signals and Systems (L043		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements				
•	Mathematics 1-3			
	The modul is an introduction to the theory of s covered by the moduls Mathematik 1-3 is expect (Fourier series, Fourier transform, Laplace transfo	ted. Further experience w	ith spectral t	
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal.			
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal and system theory. They can analyse and design basic systems regarding important properties such as magnitude and phase response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time and frequency domain.			
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 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 Lectu	ure 56		
Credit points	6			
	Written exam			
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 pro Engeneering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German program)	: Specialisation Process E : Specialisation Bioproces ogram): Specialisation ogram): Specialisation	ngineering: s Engineerir Civil- and Mechanical	Compulsory ng: Compulso Enviroment Engineerin



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



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



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

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Courses				
litle		Тур	Hrs/wk	СР
leat Transfer (L0458)		Lecture	3	4
leat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	None			
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dy	ynamics		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
	The students are able to			
	- describe the different physical mechanism	of Heat Transfer,		
Knowledge				
	- to analyse comlex heat transfer processes	in a critical 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 groups.			
Personal Competence				
Social Competence	The students are able to discuss in small gro	oups and develop an approach		
Autonomy	The students are able to develop a comp critical way. A qualified exchange with other		nd analyse t	he results in
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 p	rogram): Specialisation Mech	anical Engi	neering, Foc
	Biomechanics: Compulsory			
	General Engineering Science (German p Energy Systems: Compulsory	orogram): Specialisation Mech	anical Engi	neering, Foc
	General Engineering Science (German prog	gram): Specialisation Biomedica	al Engineeri	ng: Compulso
			a Engineen	
	General Engineering Science (German p	rogram): Specialisation Mech	-	
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp	orogram): Specialisation Mech ulsory	anical Engi	neering, Foc
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog	orogram): Specialisation Mech ulsory	anical Engi	neering, Foc
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp	rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatio	anical Engi on Mechanic	neering, Foc al Engineerir
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog Focus Energy Systems: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering:	rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatic gram, 7 semester): Specialisatic Compulsory	anical Engi on Mechanic on Mechanic	neering, Foc al Engineerir al Engineerir
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog Focus Energy Systems: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: General Engineering Science (German prog	rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatic gram, 7 semester): Specialisatic Compulsory	anical Engi on Mechanic on Mechanic	neering, Foc al Engineerir al Engineerir
Assignment for the Following Curricula	General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog Focus Energy Systems: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: General Engineering Science (German prog Compulsory General Engineering Science (English prog General Engineering Science (English prog	rrogram): Specialisation Mech ulsory gram, 7 semester): Specialisatic gram, 7 semester): Specialisatic Compulsory gram, 7 semester): Specialisatic rram): Specialisation Biomedica	anical Engi on Mechanic on Mechanic on Biomedic I Engineerir	neering, Foc al Engineerir al Engineerir al Engineerir g: Compulso
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog Focus Energy Systems: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: General Engineering Science (German prog Compulsory General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog Biomechanics: Compulsory	rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatio gram, 7 semester): Specialisatio Compulsory gram, 7 semester): Specialisatio ram): Specialisation Biomedica rogram): Specialisation Mech	anical Engi on Mechanic on Mechanic on Biomedic I Engineerir anical Engi	neering, Foc al Engineerir al Engineerir al Engineerir ng: Compulso neering, Foc
	General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog Focus Energy Systems: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: General Engineering Science (German prog Compulsory General Engineering Science (English prog General Engineering Science (English prog	rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatio gram, 7 semester): Specialisatio Compulsory gram, 7 semester): Specialisatio ram): Specialisation Biomedica rogram): Specialisation Mech	anical Engi on Mechanic on Mechanic on Biomedic I Engineerir anical Engi	neering, Foc al Engineerir al Engineerir al Engineerir ng: Compulso neering, Foc



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

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

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

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Courses					
Title		Тур	Hrs/wk	СР	
Production Engineering I (LC	0608)	Lecture	2	2	
Production Engineering I (L0612)		Recitation Section (large)	1	1	
Production Engineering II (L		Lecture	2	2	
Production Engineering II (L					
Module Responsible	Prof. Wolfgang Hintze				
Admission Beguirements	None				
Requirements					
Recommended	no course assessments required				
	internship recommended				
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional					
Competence					
	Students are able to				
Knowledge	<ul> <li>name basic criteria for the selection of manufacturing processes.</li> <li>name the main groups of Manufacturing Technology.</li> <li>name the application areas of different manufacturing processes.</li> <li>name boundaries, advantages and disadvantages of the different manufacturing process.</li> <li>describe elements, geometric properties and kinematic variables and requirements for too workpiece and process.</li> <li>explain the essential models of manufacturing technology.</li> </ul>				
Skills	<ul> <li>Students are able to</li> <li>select manufacturing processes in accordance with the requirements.</li> <li>design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced.</li> <li>assess components in terms of their production-oriented construction.</li> </ul>				
Personal Competence					
	Students are able to				
Social Competence	<ul> <li>develop solutions in a production environment with qualified personnel at technical level at represent decisions.</li> </ul>			hnical level an	
Autonomy	<ul> <li>Students are able to</li> <li>interpret independently the manufacturing process.</li> <li>assess own strengths and weaknesses in general.</li> <li>assess their learning progress and define gaps to be improved.</li> <li>assess possible consequences of their actions.</li> </ul>				
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 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 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 gualification: Compulsory
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Course L0608: Production	on Engineering I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	<ul> <li>Manufacturing Accuracy</li> <li>Manufacturing Metrology</li> <li>Measurement Errors and Uncertainties</li> <li>Introduction to Forming</li> <li>Massiv forming and Sheet Metal Forming</li> <li>Introduction to Machining Technology</li> <li>Geometrically defined machining (Turning, milling, drilling, broaching, planning)</li> </ul>
Literature	<ul> <li>Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;)</li> <li>Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007</li> <li>Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004</li> <li>Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008</li> <li>Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008</li> <li>Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008)</li> <li>Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006</li> <li>Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996</li> <li>Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)</li> </ul>

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



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

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



Courses				
<b>Title</b> Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	chatronic Systems (L1823)	<b>Typ</b> Lecture Recitation Section (large) Practical Course	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible				
Admission	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory	and electrical engineering		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
	Students are able to describe methods optimization of mechatronic systems.	and calculations for design,	modeling,	simulation a
	Students are able to apply modern algorith simulate and design simple systems and im			ney can iden <sup>.</sup>
Personal Competence				
-	Students are able to work goal-oriented in small mixed groups and present results to target group			rget groups.
Autonomy	Students are able to recognize and improve With instructor assistance, students are a further course of study.		-	el and define
Workload in Hours	Independent Study Time 124, Study Time ir	n Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German p Mechatronics: Compulsory General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Aircraft Systems Engineering: Compu General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (German pro Focus Theoretical Mechanical Engineering General Engineering Science (English p Aircraft Systems Engineering: Compulsory General Engineering Science (English p Mechatronics: Compulsory General Engineering Science (English pro Focus Mechatronics: Compulsory General Engineering Science (English pro Focus Mechatronics: Compulsory General Engineering Science (English pro Focus Mechatronics: Compulsory General Engineering Science (English pro Focus Aircraft Systems Engineering: Comp General Engineering Science (English pro Focus Theoretical Mechanical Engineering Mechanical Engineering: Specialisation Air Mechanical Engineering: Specialisation Air Mechanical Engineering: Specialisation Th	program): Specialisation Mecha program): Specialisation Mecha gram, 7 semester): Specialisation gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation selective Compulsory program): Specialisation Mecha program): Specialisation Mecha program): Specialisation Mecha program): Specialisation Mecha program): Specialisation Mecha program, 7 semester): Specialisation gram, 7 semester): Specialisation gram, 7 semester): Specialisation ulsory gram, 7 semester): Specialisation craft Systems Engineering: Com- protatronics: Compulsory	anical Engi anical Engi on Mechanic on Mechanic on Mechanic anical Engi anical Engi on Mechanic on Mechanic on Mechanic	neering, Foo neering, Foo cal Engineeri cal Engineeri cal Engineeri neering, Foo neering, Foo cal Engineeri cal Engineeri cal Engineeri



Mechatronics: Core qualification: Compulsory

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

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

Course L1824: Simulation	rse 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					
<b>Title</b> Advanced Mechanical Desig	n Project (L0266)	<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6	
Module Responsible	Dr. Jens Schmidt				
Admission Requirements					
Recommended Previous Knowledge	<ul> <li>Mechanical Engineering: Design</li> <li>Advanced Mechanical Engineering I</li> </ul>	Design			
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional Competence	After passing the module, students are able	to:			
Knowledge	<ul> <li>express the procedure for systematic</li> <li>complex design tasks ,</li> <li>describe working principles, their use</li> <li>explain guidelines for designing for f</li> <li>explain advanced use-oriented know</li> </ul>	cally handling of e and combination possibilities function and manufacturing,	,		
Skills	<ul> <li>After passing the module, students are able to:</li> <li>analyze complex tasks and develop principle solutions using sketches,</li> <li>convert principle solutions into a detailed design,</li> <li>use methods to design and solve engineering design tasks systematically and solution oriented,</li> <li>create a technical documentation including all necessary technical drawings to understand the functions of the system,</li> <li>document calculations of selected machine elements clearly and in detail.</li> </ul>				
Personal Competence					
Social Competence	<ul> <li>After passing the module, students are able to:</li> <li>present and discuss solutions and technical drawings within groups,</li> <li>reflect the own results in the work groups of the course</li> </ul>				
Autonomy	<ul> <li>After passing the module, students are able to:</li> <li>independently solve complex design projects, while motivating themselves, acquirin necessary knowledge and selecting appropriate methods,</li> <li>to independently solve problems.</li> </ul>				
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points	6				
Examination	Written exam				
Examination duration and scale	180				
	General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German p Product Development and Production: Comp General Engineering Science (German p Theoretical Mechanical Engineering: Comp General Engineering Science (German prog Focus Aircraft Systems Engineering: Compu General Engineering Science (German prog Focus Product Development and Production	rogram): Specialisation Mech pulsory rogram): Specialisation Mech ulsory gram, 7 semester): Specialisatio Ilsory gram, 7 semester): Specialisatio	anical Eng anical Eng on Mechanic	ineering, Focu ineering, Focu cal Engineerin	



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

Course L0266: 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	<ul> <li>Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.</li> <li>Getriebekonstruktion in Einzelarbeit <ul> <li>Erarbeitung von Lösungsprinzipien</li> <li>Berechnung von Maschinenelementen</li> <li>Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten</li> <li>Erstellung einer ausführlichen Dokumentation</li> </ul> </li> <li>Lösungsfindung <ul> <li>Methodische Erarbeitung von prinzipiellen Lösungskonzepten</li> <li>Erstellen einer Dokumentation</li> </ul> </li> </ul>
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); 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 Computer Engineering (L032 Computer Engineering (L032	1)	<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2				
Module Responsible		()		_				
Admission								
Requirements	None							
	<ul> <li>examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such tha respectively, up to the next-better grade.</li> </ul>	<ul> <li>The successful completion of the labs will be honored during the evaluation of the module examination according to the following rules:</li> <li>1. Upon a passed module examination, the student is granted a bonus on the examination marks due to the successful labs, such that the examination's marks are lifted by 0,3 or the examination.</li> </ul>						
Educational Objectives	After taking part successfully, students have reache	d the following learning	results					
Professional Competence								
Knowledge Skills	<ul> <li>from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subtraction, multiplication and division</li> <li>Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, caches</li> <li>Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses</li> </ul> The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software 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 o	or in a group and to prese	ent the result	s accordingly				
	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.							
Workload in Hours	Independent Study Time 124, Study Time in Lecture	e 56						
Credit points								
Examination	Written exam							
Examination duration	90 minutes, contents of course and labs							

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



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

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

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



Courses						
Title		Тур	Hrs/wk	СР		
Introduction to Control Syste Introduction to Control Syste		Lecture Recitation Section (small)	2 2	4 2		
Module Responsible	Prof. Herbert Werner					
Admission Requirements	None					
Recommended Previous Knowledge	Representation of signals and systems	in time and frequency domain, Lapl	ace transfor	m		
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results			
Professional Competence						
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>					
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain an vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks</li> </ul>					
Personal Competence						
Social Competence Autonomy	Students can work in small groups to jointly solve technical problems, and experimentally valida their controller designs Students can obtain information from provided sources (lecture notes, software documentatio experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.					
	Independent Study Time 124, Study Tim	ne in Lecture 56				
Credit points						
Examination Examination duration and scale	Written exam 120 min					
	General Engineering Science (German General Engineering Science (Germa Compulsory General Engineering Science (German	an program, 7 semester): Special	isation Con			

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



		ication: Comp cialisation III. E	•	Science: Elective	e Compu	lsory		
Theoretical	Mechanical	Engineering:	Technical	Complementary	Course	Core	Studies:	Elective
Compulsory								
Process Eng	ineering: Cor	e qualification	: Compulso	vry				

	ion to Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems   Linear systems, differential equations and transfer functions  First and second order systems, poles and zeros, impulse and step response Stability  Feedback systems  Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle  Root locus techniques Root locus design of PID controllers Frequency response techniques Root locus design of PID controllers Frequency response techniques Root locus top shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control Simith predictor  Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Courses				
<b>Title</b> Differential Equations 2 (Partial Differential Equations) (L1043) Differential Equations 2 (Partial Differential Equations) (L1044)		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 2 1	<b>CP</b> 1
	tial Differential Equations) (L1045)	Recitation Section (small) Lecture Recitation Section (small) Recitation Section (large)	1 2 1 1	1 1 1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them usin appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in the course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>		thods. In the concept	
Personal Competence				
Social Competence	<ul> <li>Students are able to work togeth common language.</li> <li>In doing so, they can communicate partners. Moreover, they can designeers.</li> </ul>	te new concepts according to the	needs of th	neir cooperating
Autonomy	<ul> <li>Students are capable of checking their understanding of complex concepts on their own. The 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 goa oriented manner on hard problems.</li> </ul>			
Workload in Hours	Independent Study Time 68, Study Time i	n Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration	60 min (Complex Functions) + 60 min (Di			

[587]

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus



eneral Engineering Science (German program): Specialisation Naval Architecture: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: ompulsory eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
ocus Mechatronics: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
ocus Theoretical Mechanical Engineering: Compulsory eneral Engineering Science (German program, 7 semester): Specialisation Naval Architecture:
ompulsory
omputer Science: Specialisation Computational Mathematics: Elective Compulsory lectrical Engineering: Core qualification: Compulsory
eneral Engineering Science (English program): Specialisation Electrical Engineering: Compulsory eneral Engineering Science (English program): Specialisation Naval Architecture: Compulsory eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus
lechatronics: Compulsory
eneral Engineering Science (English program): Specialisation Mechanical Engineering, Focus
heoretical Mechanical Engineering: Compulsory eneral Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
ompulsory
eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Mechatronics: Compulsory
eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, ocus Theoretical Mechanical Engineering: Compulsory
eneral Engineering Science (English program, 7 semester): Specialisation Naval Architecture: ompulsory
omputational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
omputational Science and Engineering: Specialisation Computer Science: Elective Compulsory
omputational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective ompulsory
lechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
lechanical Engineering: Specialisation Mechatronics: Compulsory
lechatronics: Core qualification: Compulsory
aval Architecture: Core qualification: Compulsory
heoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective ompulsory



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

ourse L1044: Different	urse 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: Different	urse L1045: Differential Equations 2 (Partial Differential Equations)		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Course L1038: Complex	Functions
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>

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

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	

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<ul> <li>Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most import aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourci supply chain management, organization and human ressource management, informat management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations und multiple objectives and uncertainty, and explain some basic methods from mathemati Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul> Students are able to analyse business units with respect to different criteria (organization, objectiv strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> </ul>	Module M0829: Fo	undations of Management			
Title         Typ         Hrs/wk         CP           Introduction to Management (L0880)         Lecture         3         3           Project Entropreneurship (L0882)         Project/citypoblem basid         2         3           Module Responsible         Prof. Christoph Ini         Admission         2         3           Module Responsible         Prof. Christoph Ini         Mone         2         3           Educational Objectives         Admission         None         2         3           Previous Knowledge         Basic Knowledge         Basic Knowledge         Basic Knowledge         Ater taking part successfully, students have reached the following learning results           Protocesional Competence         Ater taking part successfully, students have reached the following learning results         Monagement, from Planning and Organisation to Marketing and Innovation, and also to Investm and Controlling, In particularitity are able to         None         Science and Anagement, and the sub-disciplines Management and to name important definitions from the field of Management.         None         Science and explain the offerences between Economics and Management and name the most import aspects of entreprineural projects         describe and explain the ofference and ween appropriately         esplain the relevance of planning and desiston making in Business, esp. in situations un multiple objectives and uncertainty, and explain marketing esplain the relevance of planning and desision making in Businessi form	Courses				
Instruction         Learning           Module Responsible         Prof. Christoph Init           Requirements         Basic Knowledge of Mathematics and Business           Educational Objectives         Atter taking part successfully, students have reached the following learning results           Provious Knowledge         Educational Objectives         Atter taking part successfully, students have reached the following learning results           Provious Knowledge         Atter taking part successfully, students have reached the following learning results           Provious Knowledge         Atter taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to investim and Controlling, in particular they are able to           Knowledge         • explain the differences between Economics and Management and the sub-disciplines management, innovation management and name the most important aspects of and goals in Management and mana resource management, informat management, innovation management and making in Business, esp. in situations un multiple objectives and uncertainty, and explain basic business functions as production, procurement and source management, informat management, and also to facesion making in Business, esp. in situations un multiple objectives and uncertainty, and explain basic business information systems           Students are able to analyse dusiness units with respect to different criteria (organization, objective analyse of analyse of analyse of analyse of analyse dusines the form mating and decision making in Business: Information systems	Title Introduction to Management		Lecture Project-/problem-based	3	3
Admission Requirements         None           Recommended Previous Knowledge         Basic Knowledge of Mathematics and Business           Educational Objectives)         After taking part successfully, students have reached the following learning results           Provious Knowledge         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investm and Controlling. In particular they are able to <ul> <li>explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management and appects of entreprenuital projects</li> <li>explain the most important aspects of and goals in Management and name the most import aspects of entreprenuital projects</li> <li>describe and explain basic business functions as production, procurement and source supply chain management, organization and human ressource management, informat management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from mathemating in analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives. Inder uncertainty and under ri eanalyse organisational and staff structures of companies</li> <li>apply abasic methods for matcing select and apply basic methods for mathematical finance to predefined problems</li> </ul> <li>panelyse basic methods for matcing finance to predefined problems</li> <li>apply basic methods for matcing select and apply basich from accounting, costing and controlling to pred</li>			Learning	_	Ĵ
Recommended Previous Knowledge         Basic Knowledge of Mathematics and Business           Educational Objectives After taking part successfully, students have reached the following learning results           Professional Competence         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investim and Controlling. In particular they are able to <i>knowledge</i> • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management appects of entrepreturial projects <i>Knowledge</i> • explain the most important aspects of and goals in Management and name the most import aspects of entrepreturial projects <i>Knowledge</i> • describe and explain basic business functions as production, procurement and sourci supply chain management organization and human resource management, informat management, innovation management and marketing           • explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from analyses of ansistement and structures of companies           Students are able to analyse business units with respect to different criteria (organization, objectiv strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to           • analyses management goals and structures of companies           • analyses of apply basic methods from mathematical finance to predefined problems           • app					
Previous Knowledge         Besis Knowledge of Mainematics and business           Educational Objectives After taking part successfully, students have reached the following learning results           Proteinsional Competence         After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investm and Controlling. In particular they are able to <ul> <li>explain the differences between Economics and Management and the sub-disciplines 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 import aspects of entreprieurial projects</li> <li>explain the most important aspects of and goals in Management and name the most import aspects of entreprieurial projects</li> <li>explain the relevance of planning and decision marketing</li> <li>explain the relevance of planning and decision marketing</li> <li>explain the relevance of planning and selected controlling methods.</li> </ul> <li>Students are able to analyse business units with respect to different criteria (organization, objectiv strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to</li> <ul> <li>analyse modulotion and procurement systems and Business information systems</li> <li>analyse organisational and staff structures of companies</li> <li>apply basic methods from markematical finance to predefined problems</li> <li>analyse and apply basic methods from markematical finance to predefined problems</li> <li>apply basic methods from acounting, costing and controlling to predefined problems</li></ul>	riequitements				
Professional Competence       After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investm and Controlling. In particular they are able to         explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management <i>knowledge</i> explain the most important edenitions from the field of Management aspects of entrepriverial projects <i>Knowledge</i> describe and explain basic business functions as production, procurement and sourci supply chain management and marketing         explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from mathemati Finance         state basics from accounting and costing and selected controlling methods.         Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to         analyse dapply basic methods for diction making under multiple objectives, under uncertainty and under ri analyse and apply basic methods of marketing select and apply basic methods from accounting, costing and controlling to predefined problems         analyse and apply basic methods from maxing under multiple objectives, under uncertainty and under ri analyse and apply basic methods from accounting, costing and controlling to predefined problems         Students are able to       work successtully in a team of students. <td>Previous Knowledge</td> <td>Basic Knowledge of Mathematics and Busi</td> <td></td> <td></td> <td></td>	Previous Knowledge	Basic Knowledge of Mathematics and Busi			
Competence           After taking this module, students know the important basics of many different areas in Business a Management, from Planning and Organisation to Marketing and Innovation, and also to Investim and Controlling. In particular they are able to <ul> <li>explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management.</li> <li>explain the most important absorbs of and goals in Management and name the most import aspects of entreprenerial projects</li> <li>explain the most important absorbs of and goals in Management and name the most import aspects of entreprenerial projects</li> <li>explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from mathematic Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul> <li>Students are able to analyse business units with respect to different criteria (organization, objectiv strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse organizational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under ri analyse and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> <li>apply basic methods from acounting, costing and controlling to predefined problems&lt;</li>	Educational Objectives	After taking part successfully, students hav	e reached the following learnin	g results	
Management, from Planning and Organisation to Marketing and Innovation, and also to Investime and Controlling. In particular they are able to         Knowledge       • explain the differences between Economics and Management and the sub-disciplines Management and to name important definitions from the field of Management aspects of entrepresental projects         Knowledge       • explain the most important aspects of and goals in Management and name the most import aspects of entrepresental projects         • describe and explain basic business functions as production, procurement and sourci supply chain management, organization and human ressource management, information management and marketing         • explain the relevance of planning and decision making in Business, esp. in situations un multiple objectives and uncertainty, and explain some basic methods from mathemati Finance         • state basics from accounting and costing and selected controlling methods.         Students are able to analyse business units with respect to different criteria (organization, objective analyse organisational and stat structures of companies         • analyse Management goals and structure them appropriately         • analyse and apply basic methods from mathematical finance to predefined problems         • analyse and apply basic methods from mathematical finance to predefined problems         • analyse and apply basic methods from mathematical finance to predefined problems         • analyse and apply basic methods from mathematical finance to predefined problems         • analyse and apply basic methods from accountrolling to predefined problems			e important basics of many dif	ferent areas i	n Business and
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 ri         analyse production and procurement systems and Business information systems         analyse and apply basic methods from mathematical finance to predefined problems         select and apply basic methods from accounting, costing and controlling to predefined problems         apply their knowledge from the lecture to an entrepreneurship project and write a cohern report on the project         to apply their knowledge from the lecture to an entrepreneurship project and write a cohern report on the project         to computence         Students are able to         work successfully with their fellow students.         Students are able to         work in a team and to organize the team themselves         to cooperate respectfully with their fellow students.         Students are able to         work in a team and to organize the team themselves         to write a report on their project.         Morkload in Hours         Independent Study Time 110, Study Time in Lecture 70         Credit points       6	Knowledge	<ul> <li>and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, informatio management, innovation management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> </ul>			
Social CompetenceStudents are able toSocial Competence• work successfully in a team of students • to apply their knowledge from the lecture to an entrepreneurship project and write a coherr report on the project • to communicate appropriately and • to cooperate respectfully with their fellow students.AutonomyStudents are able to • work in a team and to organize the team themselves • to write a report on their project.Workload in HoursIndependent Study Time 110, Study Time in Lecture 70Credit points6ExaminationSubject theoretical and practical work	Skills	<ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under ris</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> </ul>		y are able to y and under risk is ems	
Social Competence       • work successfully in a team of students         • to apply their knowledge from the lecture to an entrepreneurship project and write a coherreport on the project         • to communicate appropriately and         • to cooperate respectfully with their fellow students.         Students are able to         • work in a team and to organize the team themselves         • to write a report on their project.         Workload in Hours       Independent Study Time 110, Study Time in Lecture 70         Credit points       6         Examination       Subject theoretical and practical work	Personal Competence				
Autonomy       • work in a team and to organize the team themselves         • to write a report on their project.         Workload in Hours       Independent Study Time 110, Study Time in Lecture 70         Credit points       6         Examination       Subject theoretical and practical work	Social Competence	<ul> <li>work successfully in a team of stude</li> <li>to apply their knowledge from the report on the project</li> <li>to communicate appropriately and</li> </ul>	lecture to an entrepreneurship	project and v	write a coheren
Credit points 6 Examination Subject theoretical and practical work	Autonomy	<ul> <li>work in a team and to organize the</li> </ul>	team themselves		
Examination Subject theoretical and practical work	Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
	Credit points	6			
Examination duration	Examination	Subject theoretical and practical work			
I Several Written exams during the semester	Examination duration	several written exams during the semester			



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

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



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



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



## **Specialization Biomedical Engineering**

The requirements into the health system increase continuously due to the aging population and the increasing expectations for the quality in life. A major aspect in this development is medical technology. This ranges from individual implants and prostheses to complex imaging and therapy equipment and its operation. Medical specialists and well educated engineers will have to cooperate closer and closer to understand the requirements from either side and develop solutions together. In order to cooperate, the engineers need in addition to their core engineering skills, a basic understanding of the "other" fields, which are Medicine and Economy. This enables them to understand operational planning as well as research and development in this highly interdisciplinary area. The program is aimed towards allowing the students to achieve these qualifications.

### Module M0933: Fundamentals of Materials Science

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S	Science I (L1085)	Lecture	2	2
Fundamentals of Materials Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	<sup>d</sup> Lecture	2	2
1 , ( )	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge		atics		
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 can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.			
Skills	The students are able to trace materials phenor laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosi solidification, precipitation, or melting. The stud conditions and the materials microstructure, and the material's behavior.	to mechanical properties ion resistance, and to pha dents can explain the re	s such as st ase transforr lation betwo	rength, ductilit mations such a een processin
Personal Competence				
Social Competence	-			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Examination	Written exam			
Examination duration and scale	100			
	General Engineering Science (German prog	gram): Specialisation E	Energy and	Enviromenta



Assignment for the Following Curricula	
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Course L1085: Fundamentals of Materials Science I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jörg Weißmüller	
Language	DE	
Cycle	WiSe	
Content		
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7	



Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider	
Language	DE	
Cycle	SoSe	
Content	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 <ul> <li>"Detour": Mathematics (complex e-funktion etc.)</li> </ul> </li> <li>The atom: Bohr's model of the atom</li> <li>Chemical bounds</li> <li>The multi part problem: Solutions and strategies</li> <li>Descriptions of using statistical thermodynamics</li> <li>Elastic theory of atoms</li> <li>Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)</li> </ul>
Literature	<ul> <li>Für den Elektromagnetismus:</li> <li>Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter</li> <li>Für die Atomphysik: <ul> <li>Haken, Wolf: "Atom- und Quantenphysik", Springer</li> </ul> </li> <li>Für die Materialphysik und Elastizität: <ul> <li>Hornbogen, Warlimont: "Metallkunde", Springer</li> </ul> </li> </ul>



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
· ·	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	<ul> <li>The successful completion of the labs will be examination according to the following rules:</li> <li>1. Upon a passed module examination, the marks due to the successful labs, such the respectively, up to the next-better grade.</li> <li>2. The improvement of the grade 5,0 up to 4,3</li> </ul>	e student is granted a b nat the examination's ma	onus on the Irks are liftec	examination's
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the fur from the assembly-level programming down to gate introduction</li> <li>Combinational logic: Gates, Boolean a combinational networks</li> <li>Sequential logic: Flip-flops, automata, syste</li> <li>Technological foundations</li> <li>Computer arithmetic: Integer addition, subte</li> <li>Basics of computer architecture: Prograpipelining</li> <li>Memories: Memory hierarchies, SRAM, DF</li> <li>Input/output: I/O from the perspective of connections, busses</li> </ul> The students perceive computer systems from the structure and the physical composition of compute specific and individual computers can be built bather and the consequences that the execution layers from the assembly language down to gati impact that these low abstraction levels have of feasible options.	tes. The module includes algebra, Boolean functi ematic hardware design traction, multiplication and amming models, MIPS RAM, caches the CPU, principles of p e architect's perspective, i ter systems. The studen ased on a collection of fe explain the different ab complete processors. students are able to jud software executed on of software has on the h tes. This way, they will b	the following ions, hardw d division single-cycle bassing data .e., they iden ts can analy w and simpl ostraction lay dge the inter it. In particu ardware-cen be enabled t	topics: are synthesis are synthesis are architecture , point-to-poin tify the interna ze, how highly e components ers of today's rdependencies lar, they shal tric abstraction o evaluate the
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from with other classes.	m specific literature and t	o associate t	his knowledge
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
Examination	Written exam			
Eveningtion dynation				

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

### TUHH

### 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: 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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Hrs/wk 3 (large) 1	<b>CP</b> 4 2
Mathematics 1-3 The modul is an introduction to the theory of signals and systems. Good knowledge in maths a covered by the moduls Mathematik 1-3 is expected. Further experience with spectral transformation (Fourier series, Fourier transform, Laplace transform) is useful but not required.	
earning results	
The students are able to classify and describe signals and linear time-invariant (LTI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal.	
The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain.	
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 tool clicker system.	
omputer Science rocess Engineerin oprocess Engine sation Civil- a sation Mechani omedical Engine recialisation Elec Specialisation C pecialisation Pro cialisation Biopro cialisation Biome cialisation Mecha	ng: Compulsory ering: Compulso nd Enviroment cal Engineerin ering: Compulso trical Engineerin omputer Scienc cess Engineerin cess Engineerin dical Engineerin



	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
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urse L0432: Signals a	nd Systems
Тур	Lecture
Hrs/wk	3
СР	4
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Gerhard Bauch
Language Cycle	
Content	<ul> <li>Basic classification and description of continuous-time and discrete-time signals and systems</li> <li>Concvolution</li> <li>Power and energy of signals</li> <li>Correlation functions of deterministic signals</li> <li>Linear time-invariant (LTI) systems</li> <li>Signal transformations: <ul> <li>Fourier-Series</li> <li>Fourier Transform</li> <li>Laplace Transform</li> <li>Discrete-time Fourier Transform</li> <li>Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT)</li> <li>Z-Transform</li> </ul> </li> <li>Analysis and design of LTI systems in time and frequency domain</li> <li>Basic filter types</li> <li>Sampling, sampling theorem</li> <li>Fundamentals of recursive and non-recursive discrete-time filters</li> </ul>
Literature	<ul> <li>T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004</li> <li>K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag.</li> <li>B. Girod , R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubne Stuttgart, 1997</li> <li>J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002</li> <li>S. Haykin, B. van Veen: Signals and systems. Wiley.</li> <li>Oppenheim, A.S. Willsky: Signals and Systems. Pearson.</li> <li>Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson.</li> </ul>



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



Courses				
Title	Ту	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	None			
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engine	neering mechanics and	thermodyn	amics.
Educational Objectives	After taking part successfully, students have reached	the following learning r	results	
Professional Competence				.,
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineeri and physics of fluids. Students can scientifically outline the rationale of flow physics usi mathematical models and are familiar with methods for the performance analysis and the prediciton fluid engineering devices.		physics usir	
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis technical systems. The lecture enables the student to carry out all necessary theoretical calculatio for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly	/ develop solution strate	egies.	
Autonomy	The students are able to develop solution strategies analyse results.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory			



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

Course L0454: Fluid Mechanics			
Тур	Lecture		
Hrs/wk			
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	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course



Module M0960:N Systems)	lechanics IV (Kinetics II, Oscillations, Analytical Me	chanics,	Multibody
Courses			
<b>Title</b> Mechanics IV (Kinetics II, (L1137)	<b>Typ</b> Oscillations, Analytical Mechanics, Multibody Systems)	<b>Hrs∕wk</b> 3	<b>СР</b> 3
Mechanics IV (Kinetics II, (L1138)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small)	2	2
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large)	1	1
Module Responsible			
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III		
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional Competence			
Knowledge	<ul> <li>describe the axiomatic procedure used in mechanical contexts;</li> </ul>		
Skills	<ul> <li>explain the important elements of mathematical / mechanical and 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 the problem sets.</li> </ul>	-	
Personal Competence			
Social Competence	The students can work in groups and support each other to overcome difficu	ulties.	
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Examination	Written exam		
Examination duration and scale	120 min		
Assignment for the Following Curricula		al Engineerin hitecture: Co on Mechanic on Biomedic isation Nava al Engineerin I Engineerin hitecture: Co	ng: Compulso ompulsory al Engineerin al Engineerin al Architectur ng: Compulso ng: Compulsor mpulsory
<b>2</b>			



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

Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> </ul>
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009) D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011) W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

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



Course L1139: Mechanic	ourse 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		



Module M1277: ME	ED I: Introduction to Anatomy			
Courses				
Title Introduction to Anatomy (L0384)		<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Udo Schumacher			
nequirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students h	ave reached the following le	arning results	
Professional Competence				
Knowledge	The students can describe basal structures and functions of internal organs and the musculoskeleta system. The students can describe the basic macroscopy and microscopy of those systems.			
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; they can explain the relevance of structures and their functions in the contex of widespread diseases.			
Personal Competence				
Social Competence	The students can participate in curre professional level.	nt discussions in biomedic	al research and	medicine on a
Autonomy	The students are able to access a conversations on the topic and acquire t			participate in
Workload in Hours	Independent Study Time 62, Study Time	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 Compulsory General Engineering Science (German Focus Biomechanics: Compulsory Electrical Engineering: Specialisation M General Engineering Science (English Biomechanics: Compulsory General Engineering Science (English General Engineering Science (English General Engineering Science (English General Engineering Science (English Focus Biomechanics: Compulsory General Engineering Science (English Focus Biomechanics: Compulsory General Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Compulsory Biomedical Engineering: Specialisation Technomathematics: Specialisation III. E	program): Specialisation Bio program, 7 semester): Speci edical Technology: Elective h program): Specialisation brogram): Specialisation Bior brogram): Specialisation Bior brogram, 7 semester): Speci Biomechanics: Compulsory Medical Technology and Co on Management and Bu on Artificial Organs and F Implants and Endoprosthese	medical Engineeri ialisation Biomedic alisation Mechanic Compulsory Mechanical Engi medical Engineerir alisation Mechanic alisation Biomedic antrol Theory: Elect usiness Administr Regenerative Mec	ng: Compulsory cal Engineering: cal Engineering, neering, Focus ng: Compulsory cal Engineering; cal Engineering: ive Compulsory ration: Elective dicine: Elective



Course L0384: Introduct	on to Anatomy		
	Lecture		
Hrs/wk			
CP			
	I- Independent Study Time 62, Study Time in Lecture 28		
	Prof. Tobias Lange		
Language	DE		
Cycle	SoSe		
Content	General Anatomy1 st week:The Eucaryote Cell2nd week:The Tissues3rd week:Cell Cycle, Basics in Development4th week:Musculoskeletal System5th week:Cardiovascular System6th week:Respiratory System7th week:Genito-urinary System8th week:Immune system9th week:Digestive System I		
	10 <sup>th</sup> week:Digestive System II11 <sup>th</sup> week:Endocrine System12 <sup>th</sup> week:Nervous System13 <sup>th</sup> week:Exam		
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012	12	



Courses				
Title		Тур	Hrs/wk	СР
	d Radiation Therapy (L0383)	Lecture	2	3
Module Responsible	Prof. Ulrich Carl			
Admission	None			
Requirements Recommended				
Previous Knowledge	None			
Educational Objectives	After taking part successfully, students	have reached the following I	earning results	
Professional Competence				
	<b>Therapy</b> The students can distinguish different radiation therapy.	nt types of currently used ec	quipment with respe	ct to its use
	The students can explain treatment p surgery, internal medicine).	lans used in radiation therap	oy in interdisciplinar	y contexts (e
	The students can describe the patie care.	nts' passage from their initi	al admittance throu	gh to follow
	Diagnostics			
Knowledge	The students can illustrate the te angiography and mammography, as w			
	The students can explain the diagnos the technical basis for those technique	-	e of imaging techniq	ues, as well
	The students can choose the right troneeds.	eatment method depending	on the patient's clini	ical history a
	The student can explain the influence	of technical errors on the ima	iging techniques.	
	The student can draw the right conc protocol.	clusions based on the image	es' diagnostic findin	gs or the er
	<b>Therapy</b> The students can distinguish curative conclusion.	e and palliative situations ar	nd motivate why the	ey came to t
	The students can develop adequate the	nerapy concepts and relate it	to the radiation biolo	gical aspect
	The students can use the therapeutic	principle (effects vs adverse e	effects)	
	The students can distinguish differen situation (location of the tumor) and ch			-
Skills	The student can assess what an in treatment, sports, social help groups, s			
	Diagnostics			
	The students can suggest solutions analyses.	for repairs of imaging instru	imentation after hav	ring done er
	The students can classify results of based on their knowledge of anatomy			ps of diseas
Personal Competence				
·	The students can assess the specia	I social situation of tumor pa	atients and interact	with them ir
Social Competence	professional way. The students are aware of the spe-	cial, often fear-dominated be	ehavior of sick peo	ple caused
	10			



	diagnostic and therepoutie measures and can most them appreciately		
	diagnostic and therapeutic measures and can meet them appropriately.		
	The students can apply their new knowledge and skills to a concrete therapy case.		
	The students can introduce younger students to the clinical daily routine.		
Autonomy	The students are able to access anatomical knowledge by themselves, can participate competently in		
	conversations on the topic and acquire the relevant knowledge themselves.		
	Independent Study Time 62, Study Time in Lecture 28		
Credit points	3		
	Written exam		
Examination duration	90 minutes		
and scale			
	General Engineering Science (German program): Specialisation Mechanical Engineering, Focus		
	Biomechanics: Compulsory		
	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:		
	Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,		
	Focus Biomechanics: Compulsory		
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory		
	General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory		
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory		
Assignment for the Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,		
Following Curricula	Focus Biomechanics: Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:		
	Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory		
	Biomedical Engineering: Specialisation Biomedical 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		
	recimonationatics. Specialisation III. Engineening Science. Elective Compuisory		



Hrs/wk CP	2
СР	
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Ulrich Carl, Prof. Thomas Vestring
Language Cycle	
	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units which determine a predefined sequence in their respective departments
	• "Technik der medizinischen Radiologie" von T. + J. Laubenberg –
	7. Auflage – Deutscher Ärzteverlag – erschienen 1999
	• "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr –
	4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006
	ISBN: 978-3-437-23960-1
	<ul> <li>"Strahlentherapie und Onkologie f ür MTA-R" von R. Sauer –</li> </ul>
	5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschiene 08.12.2009
	ISBN: 978-3-437-47501-6
Literature	"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	<ul> <li>"Praxismanual Strahlentherapie" von Stöver / Feyer –</li> </ul>
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000



Courses				
<b>Title</b> Embodiment Design and 3D- Mechanical Design Project I Mechanical Design Project II Team Project Design Method	(L0695) (L0592)	<b>Typ</b> Lecture Practical Course Practical Course Project-/problem-base Learning	Hrs/wk 2 3 3 d 2	<b>CP</b> 1 2 2 1
Module Responsible	Prof. Dieter Krause			
Admission Requirements				
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learr	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	<ul> <li>After passing the module, students are able to:</li> <li>independently create sketches, technical drawings and documentations e.g. using 3D CAD,</li> <li>design components based on design guidelines autonomously,</li> <li>dimension (calculate) used components,</li> <li>use methods to design and solve engineering design tasks systamtically and solution-oriented</li> <li>apply creativity techniques in teams.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>After passing the module, students are able to:</li> <li>develop and evaluate solutions in groups including making and documenting decisions,</li> <li>moderate the use of scientific methods,</li> <li>present and discuss solutions and technical drawings within groups,</li> <li>reflect the own results in the work groups of the course.</li> </ul>			
Autonomy	<ul> <li>Students are able</li> <li>to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),</li> <li>To solve engineering design tasks systematically.</li> </ul>			
	Independent Study Time 40, Study Time in Lecture 140			
Credit points				
Examination Examination duration	Written exam 180			
and scale	General Engineering Science (Gerr Engineering: Compulsory General Engineering Science (Ger Compulsory General Engineering Science (German General Engineering Science (German	man program): Specialisation program): Specialisation Biome	on Mechanica dical Engineeri	l Engineering



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

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



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

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



Course L0267: Team Pro	oject Design Methodology		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Introduction to engineering designing methodology</li> <li>Team Project Design Methodology         <ul> <li>Creating requirement lists</li> <li>Problem formulation</li> <li>Creating functional structures</li> <li>Finding solutions</li> <li>Evaluation of the found concepts</li> <li>Documentation of the taken methodological steps and the concepts using presentation slides</li> </ul> </li> </ul>		
Literature	<ul> <li>Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.</li> <li>Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.</li> <li>Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.</li> <li>Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.</li> <li>Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.</li> <li>Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.</li> <li>Sowie weitere Bücher zu speziellen Themen</li> </ul>		



		_		
Title Numerical Mathematics I (L	0417)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Numerical Mathematics I (L		Recitation Section (small)	2	3
	Prof. Sabine Le Borne			
Admission				
Requirements	None			
Recommended Previous Knowledge	I for Technomathematicians			
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional				
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> <li>repeat convergence statements for the numerical methods,</li> <li>explain aspects for the practical execution of numerical methods with respect to computationa and storage complexitx.</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>implement, apply and compare numerical methods using MATLAB,</li> <li>justify the convergence behaviour of numerical methods with respect to the problem an solution algorithm,</li> <li>select and execute a suitable solution approach for a given problem.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work together in heterogeneously con and background knowledge), explai practical aspects regarding the impler</li> </ul>	n theoretical foundations an		
Autonomy	<ul> <li>Students are capable</li> <li>to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,</li> <li>to assess their individual progess and, if necessary, to ask questions and seek help.</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German progr General Engineering Science (German progr Biomechanics: Compulsory General Engineering Science (German progr Materials in Engineering Sciences: Compulso General Engineering Science (German progr General Engineering Science (German progr Compulsory General Engineering Science (German progr Focus Materials in Engineering Sciences: Co	ogram): Specialisation Mech ogram): Specialisation Mech ory am): Specialisation Biomedica ogram, 7 semester): Specialisation am, 7 semester): Specialisation	anical Engi anical Engi al Engineerin isation Com	neering, Foc neering, Foc ng:Compulso nputer Scienc



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

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



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



Courses					
Title		Тур	Hrs/wk	СР	
Heat Transfer (L0458) Heat Transfer (L0459)		Lecture Recitation Section (large)	3 2	4 2	
Module Responsible	Dr. Andreas Moschallski				
Admission Requirements	None				
Recommended Previous Knowledge	Lechnical Inermodynamics Lilland Fillid Livna	amics			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results		
Professional Competence					
	The students are able to				
	- describe the different physical mechanism of	Heat Transfer,			
Knowledge	- explain the technical terms,				
	- to analyse comlex heat transfer processes in	a critical way.			
	The students are able to				
	- understand the physics of Heat Transfer,				
Skills	- calculate and evaluate complex Heat Transfer processes,				
	- solve excersises self-consistent and in small groups.				
Personal Competence					
Social Competence	The students are able to discuss in small group	os and develop an approach			
Autonomy	The students are able to develop a complex problem self-consistent and analyse the results in critical way. A qualified exchange with other students is given.				
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70			
Credit points	6				
	Written exam				
Examination duration and scale	1120 min				
	General Engineering Science (German proc	gram): Specialisation Mech	anical Engi	neering, Focu	
	Biomechanics: Compulsory General Engineering Science (German prog	gram): Specialisation Mech	anical Engi	neering, Focu	
	Energy Systems: Compulsory		_	-	
	General Engineering Science (German progra General Engineering Science (German prog				
	Theoretical Mechanical Engineering: Compuls	ory	· ·		
	General Engineering Science (German progra Focus Energy Systems: Compulsory	m, 7 semester): Specialisatio	on Mechanic	al Engineerin	
	General Engineering Science (German progra		on Mechanic	al Engineerin	
	Focus Theoretical Mechanical Engineering: Co General Engineering Science (German progra		on Biomedic	al Engineerin	
Assignment for the	Focus Theoretical Mechanical Engineering: Co General Engineering Science (German progra Compulsory	m, 7 semester): Specialisatio		-	
Assignment for the Following Curricula	Focus Theoretical Mechanical Engineering: Co General Engineering Science (German progra Compulsory General Engineering Science (English program General Engineering Science (English prog	m, 7 semester): Specialisation): Specialisation	I Engineerir	ıg: Compulsor	
	Focus Theoretical Mechanical Engineering: Co General Engineering Science (German progra Compulsory General Engineering Science (English progra General Engineering Science (English prog Biomechanics: Compulsory	m, 7 semester): Specialisation): Specialisation n): Specialisation Biomedica gram): Specialisation Mech	I Engineerir anical Engi	ng: Compulsor neering, Focu	
	Focus Theoretical Mechanical Engineering: Co General Engineering Science (German progra Compulsory General Engineering Science (English program General Engineering Science (English prog	m, 7 semester): Specialisation): Specialisation Biomedica gram): Specialisation Mech gram): Specialisation Mech	I Engineerir anical Engi anical Engi	ng: Compulson neering, Focu neering, Focu	



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

Course L0458: Heat Tra	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 Tra	Course L0459: Heat Transfer	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Andreas Moschallski	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	



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



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



Course L1119: Practical	Course: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
CP	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
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 BI.1, 2451 BI.4, 2453 BI.5, 2455 BI.1</li> </ul>
Literature	<ul> <li>Versuch 2:</li> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> <li>Versuch 4:</li> </ul>
	<ul> <li>Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden</li> <li>Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen</li> </ul>



	ment Technology for Mechanical and Process Engineers
	Lecture
Hrs/wk CP	
	S Independent Study Time 62, Study Time in Lecture 28
	Dr. Sven Krause
Language	DE
Cycle	WiSe
	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
Orminat	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 fron the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940.



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



Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry	and Molecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students h	ave reached the following le	earning results	
Professional Competence	The students can			
Knowledge	describe basic biomolecules:			
Skills	<ul> <li>The students can</li> <li>recognize the importance of molecular parameters for the course of a disease;</li> <li>describe selected molecular-diagnostic procedures;</li> <li>explain the relevance of these procedures for some diseases</li> </ul>			
Personal Competence				
Social Competence	The students can participate in discussion	ons in research and medicin	e on a technical le	vel.
Autonomy	The students can develop understand themselves.	ing of topics from the cou	rse, using technic	al literature, b
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points	3			
Examination				
Examination duration and scale				
Assignment for the Following Curricula				

1-



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



Courses				
Title		Тур	Hrs/wk	СР
Introduction to Control Syste Introduction to Control Syste		Lecture Recitation Section (small)	2 2	4 2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapl	ace transfor	m
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems</li> <li>They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain are implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups to jo their controller designs Students can obtain information from p experiment guides) and use it when solvir	provided sources (lecture notes	-	-
Autonomy	They can assess their knowledge in week	ly on-line tests and thereby contro	ol their learn	ing progress.
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	·			
	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German pr General Engineering Science (German Compulsory General Engineering Science (German pr	program, 7 semester): Speciali	isation Con	

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



	•	fication: Comp cialisation III. E	,	Science: Elective	e Compul	lsory		
Theoretical	Mechanical	Engineering:	Technical	Complementary	Course	Core	Studies:	Elective
Compulsory								
Process Eng	ineering: Cor	re qualification	: Compulso	ry				

ourse L0654: Introduct	ion to Control Systems
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems         Linear systems, differential equations and transfer functions         First and second order systems, poles and zeros, impulse and step response         Stability         Feedback systems         Principle of feedback, open-loop versus closed-loop control         Reference tracking and disturbance rejection         Types of feedback, PID control         System type and steady-state error, error constants         Internal model principle         Root locus techniques         Root locus bolts         Root locus design of PID controllers         Frequency response techniques         Nyquist plot, Nyquist stability criterion, phase and gain margin         Loop shaping, lead lag compensation         Frequency response interpretation of PID control         Time delay systems         Root locus and frequency response of time delay systems         Smith predictor         Digital control         Sampled-data systems, difference equations         Tustin approximation, digital implementation of PID controllers         Software tools         Introduction to Matlab, Simulink, Control toolbox         Computer-based exercises throughout the course
Literature	<ul> <li>Werner, H., Lecture Notes "Introduction to Control Systems"</li> <li>G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009</li> <li>K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010</li> <li>R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010</li> </ul>



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



Module M1333: Blo	DI: Implants and Fracture Healing			
Courses				
Title Implants and Fracture Healing	ng (L0376) Typ		Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "Introduction in Fracture Healing".	to Anatomie" before	attending	"Implants and
Educational Objectives	After taking part successfully, students have reached th	e following learning r	esults	
Professional Competence				
	The students can describe the different ways how existence. The students can name different treatments for the smorphologies.			
Skills	The students can determine the forces acting within under specific assumptions.	the human body un	der quasi-st	atic situations
Personal Competence				
Social Competence	The students can, in groups, solve basic numerical mod	deling tasks for the ca	lculation of i	nternal forces
Autonomy	The students can, in groups, solve basic numerical mod	deling tasks for the ca	lculation of i	nternal forces
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points				
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): S Biomechanics: Compulsory General Engineering Science (German program): Spec General Engineering Science (German program, 7 sen Focus Biomechanics: Compulsory General Engineering Science (German program, 7 sen Compulsory General Engineering Science (English program): Spec General Engineering Science (English program): S Biomechanics: Compulsory General Engineering Science (English program, 7 sen Focus Biomechanics: Compulsory General Engineering Science (English program, 7 sen Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics Biomedical Engineering: Specialisation Artificial O Compulsory Biomedical Engineering: Specialisation Implants and E Biomedical Engineering: Specialisation Medical Techn Biomedical Engineering: Specialisation Medical Techn Biomedical Engineering: Specialisation Managem Compulsory Technomathematics: Specialisation III. Engineering Sci	cialisation Biomedical nester): Specialisation nester): Specialisation ialisation Biomedical pecialisation Mechan nester): Specialisation nester): Specialisation rester): Specialisation compulsory rgans and Regener indoprostheses: Elect ology and Control The ent and Business	Engineering n Mechanica n Biomedica Engineering nical Engine n Mechanica n Biomedica rative Medie ive Compuls eory: Electiv Administra	g: Compulsory I Engineering I Engineering I: Compulsory eering, Focus I Engineering I Engineering cine: Elective sory e Compulsory



Тур	Lecture
Hrs/wk	2
СР	3
Vorkload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	
Cycle	
	Topics to be covered include:
	<ol> <li>Introduction (history, definitions, background importance)</li> <li>Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)</li> </ol>
	<ol> <li>Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)</li> </ol>
	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



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



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

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English 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
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory



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



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

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Module M0634: Int	roduction into Medical Technology a	and Systems		
Courses				
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)	Hrs/wk 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/calculus) principles of stochastics principles of programming, R/Matlab			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence		technology including in		
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 systems and me	edical devices in the conte	ext of clinical	applications.
Personal Competence				
Social Competence	The students describe a problem in medical techn in a joint effort.	nology as a project, and c	define tasks	that are solved
Autonomy	The students can reflect their knowledge and doc results in an appropriate manner.	ument the results of their	work. They o	can present the
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70		
Credit points				
Examination	Written exam			
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			



Course L0342: Introduct	ion into Medical Technology and Systems
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe
Content	<ul> <li>imaging systems</li> <li>computer aided surgery</li> <li>medical sensor systems</li> <li>medical information systems</li> <li>regulatory affairs</li> <li>standard in medical technology</li> <li>The students will work in groups to apply the methods introduced during the lecture using problem based learning.</li> </ul>
Literature	Wird in der Veranstaltung bekannt gegeben.

Course L0343: Introduct	urse L0343: Introduction into Medical Technology and Systems		
Тур	Project Seminar		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Alexander Schlaefer		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1876: Introduct	ourse L1876: Introduction into Medical Technology and Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Alexander Schlaefer		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>imaging systems</li> <li>computer aided surgery</li> <li>medical sensor systems</li> <li>medical information systems</li> <li>regulatory affairs</li> <li>standard in medical technology</li> <li>The students will work in groups to apply the methods introduced during the lecture using problem based learning.</li> </ul>		
Literature	Wird in der Veranstaltung bekannt gegeben.		



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



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



Module M1332: Bl	O I: Experimental Methods in B	iomechanics		
Courses				
<b>Title</b> Experimental Methods in Bic	mechanics (L0377)	<b>Typ</b> Lecture	Hrs/wk 2	<b>СР</b> 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "Impl Methoden".	antate und Frakturheilung	" before attending '	"Experimentelle
Educational Objectives	After taking part successfully, students ha	ve reached the following le	earning 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. The students can describe different measurement techniques for forces and movements, and choose the adequate technique for a given task.			
Skills	The students can describe the basic biomechanics.	handling of several e	experimental techn	iques used in
Personal Competence				
Social Competence	The students can, in groups, solve basic e	experimental tasks.		
Autonomy	The students can, in groups, solve basic e	experimental tasks.		
Workload in Hours	Independent Study Time 62, Study Time i	n Lecture 28		
Credit points	3			
	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program): Specialisation Mechanical Engineering, F Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compu General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineer Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compul General Engineering Science (English program): Specialisation Mechanical Engineering, F Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, F Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Ele Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compu Biomedical Engineering: Specialisation Management and Business Administration: Ele Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		ng: Compulsory al Engineering al Engineering ng: Compulsory neering, Focus al Engineering al Engineering dicine: Elective	



Course L0377: Experime	urse L0377: Experimental Methods in Biomechanics		
Тур	Lecture		
Hrs/wk	2		
CP	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: Int	roduction to Control Systems			
Courses				
Title Introduction to Control Systems (L0654) Introduction to Control Systems (L0655)		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, students have	e 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 I vice versa</li> <li>They can simulate and assess the b</li> <li>They can design PID controllers wit</li> <li>They can analyze and synthesize frequency response techniques</li> <li>They can calculate discrete-time a and use it for digital implementation</li> <li>They can use standard software too tasks</li> </ul>	ehavior of systems and control h the help of heuristic (Ziegler-N e simple control loops with th approximations of controllers de	oops ichols) tunin ne help of esigned in o	ng rules root locus and continuous-time
Personal Competence				
Social Competence	Students can work in small groups to join their controller designs	ntly solve technical problems, a	and experim	entally validate
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			



Eveningtion	Written exam
Examination duration	
and scale	120 min
	General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science:
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Assignment for the	Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,



1	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory
	Process Engineering: Core qualification: Compulsory





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



Courses         Typ           Title         Typ           Computer Engineering (L0321)         Lecture           Computer Engineering (L0324)         Prof. Heiko Falk           Admission Requirements         None           Basic knowledge in electrical engineering         The successful completion of the labs will be honore examination according to the following rules:           Previous Knowledge         1. Upon a passed module examination, the student marks due to the successful labs, such that the ex- respectively, up to the next-better grade.           2. The improvement of the grade 5.0 up to 4.3 and of 4           Educational Objectives         After taking part successfully, students have reached the fo           Professional         This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r           Introduction         Computer architecture: Programming pipelining           Knowledge         This module deals with the foundations. Computer architecture: Programming down to gates. The r           Introduction         Computer architecture: Programming pipelining           Memories: Memory hierarchies, SRAM, DRAM, cack           Ineput/output: UC from the perspective of the CPU connections, busses           The students perceive computer system and the software specific and individual computer system and the software uderstand the consequences that the execution of softwa layers from the assembly language down to gates. This impact tha			
Computer Engineering (L0321)         Lecture Recitatio           Module Responsible Requirements         Prof. Heiko Falk           Admission Requirements         None           Basic knowledge in electrical engineering The successful completion of the labs will be honore examination according to the following rules:           Previous Knowledge         The successful completion of the labs will be honore examination according to the following rules:           1. Upon a passed module examination, the student marks due to the successful labs, such that the e respectively. up to the next-better grade.           2. The improvement of the grade 5.0 up to 4.3 and of 4           Educational Objectives         After taking part successfully, students have reached the for Professional Competence           Knowledge         This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r <ul> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic ha Technological foundations</li> <li>Computer architecture: Programming pipelining</li> <li>Memories: Memory hierarchies, SRAM, DRAM, cacl</li> <li>Input/output: I/O from the perspective of the CPU connections, busses</li> </ul> <li>Personal Competence</li> <li>Skills</li> <li>After successful computer system and the software understand the consequences that the execution of software understand the consequences that the execution of software understand the consequences that the execution of software understand the consequences that the exec</li>		Hrs/wk	СР
Module Responsible         Prof. Heiko Falk           Admission Requirements         None           Basic knowledge in electrical engineering         The successful completion of the labs will be honore examination according to the following rules:           Recommended         The successful completion of the labs will be honore examination according to the following rules:           1. Upon a passed module examination, the student marks due to the successful labs, such that the e respectively. up to the next-better grade.           2. The improvement of the grade 5,0 up to 4,3 and of 4           Educational Objectives         After taking part successfully, students have reached the fo           Professional Competence         This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r           Introduction         Combinational logic: Gates, Boolean algebra, combinational networks           Sequential logic: Filp-flops, automata, systematic he Technological foundations           Computer arithmetic: Integer addition, subtraction, r           Basics of computer architecture: Programming pipelining           Memories: Memory hierarchies, SRAM, DRAM, caci           Input/output: 1/O from the perspective of the CPU connections, busses           The students perceive computer systems from the asoftware understand the consequences that the execution of software specific and individual computer system and the software understand the consequences that the execution of software layers from the assembly language down to		3	4
Admission Requirements         None           Basic knowledge in electrical engineering         The successful completion of the labs will be honore examination according to the following rules:           Previous Knowledge         1. Upon a passed module examination, the student marks due to the successful labs, such that the e respectively, up to the next-better grade.           2. The improvement of the grade 5,0 up to 4,3 and of 4           Educational Objectives         After taking part successfully, students have reached the fo           Professional Competence         This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r           Introduction         Combinational logic: Gates, Boolean algebra, combinational networks           Sequential logic: Flip-flops, automata, systematic he Technological floundations           Computer arithmetic: Integer addition, subtraction, r           Basics of computer architecture: Programming pipelining           Memories: Memory hierarchies, SRAM, DRAM, caci Input/output: I/O from the perspective of the CPU connections, busses           The students perceive computer systems from the architec structure and the physical composition of computer syste specific and individual computer system and the sudents between a physical computer system and the software understand the consequences that the execution of	on Section (small)	1	2
Requirements         None           Basic knowledge in electrical engineering         The successful completion of the labs will be honore examination according to the following rules:           Previous Knowledge         1. Upon a passed module examination, the student marks due to the successful labs, such that the erespectively, up to the next-better grade.           2. The improvement of the grade 5,0 up to 4,3 and of 4           Educational Objectives           After taking part successfully, students have reached the to Professional Competence           Competence           Knowledge           This module deals with the foundations of the functionality from the assembly-level programming down to gates. The recombinational networks           Sequential logic: Gates, Boolean algebra, combinational networks           Sequential logic: Flip-flops, automata, systematic ha to recombinational networks           Computer arithmetic: Integer addition, subtraction, respective of the CPU connections, busses           The students perceive computer systems from the architect structure and the physical composition of computer syste specific and individual computers can be built based on a They are able to distinguish between and to explain the software understand the consequences that the execution of software understand the consequences that the execution of software layes from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.           Personal Competence         Students are able to solve similar problems alone or in a gr           Stud			
Recommended         Basic knowledge in electrical engineering           The successful completion of the labs will be honore examination according to the following rules:         1. Upon a passed module examination, the student marks due to the successful labs, such that the erespectively, up to the next-better grade.           2. The improvement of the grade 5,0 up to 4,3 and of 4           Educational Objectives           After taking part successfully, students have reached the for Professional Competence           This module deals with the foundations of the functionality from the assembly-level programming down to gates. The rechnological foundations           Knowledge           Knowledge           Knowledge           Knowledge           This module deals with the foundations of the functionality from the assembly-level programming down to gates. The rechnological foundations           Computer arithmetic: Integer addition, subtraction, regulation according the programming pipelining           Memories: Memory hierarchies, SRAM, DRAM, cacle input/output: I/O from the perspective of the CPU connections, busses           The students perceive computer systems from the architec structure and the physical composition of computer system specific and individual computer system and the software understand the consequences that the execution of software layers from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.           Personal Competence         Students are able to solve similar problems alone or in a gr			
Recommended Previous Knowledge         The successful completion of the labs will be honore examination according to the following rules:           1. Upon a passed module examination, the student marks due to the successful labs, such that the erespectively, up to the next-better grade.         2. The improvement of the grade 5,0 up to 4,3 and of 4           Educational Objectives         After taking part successfully, students have reached the for Professional Competence         This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r           Introduction         Combinational logic: Gates, Boolean algebra, combinational networks         Sequential logic: Flip-flops, automata, systematic he ereconological foundations           Knowledge         Memories: Memory hierarchies, SRAM, DRAM, caci Input/output: I/O from the perspective of the CPU connections, busses           The students perceive computer systems from the architec structure and the physical composition of computer syste specific and individual computers can be built based on a They are able to distinguish between and the explain computing systems - from gates and circuits up to complete structure and the onsequences that the execution of softwar layers from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.           Personal Competence Social Competence         Students are able to solve similar problems alone or in a gr Students are able to acquire new knowledge from specific with other classes.           Workload in Hours         Independent Study Time 124, Study Time in Lecture 56			
Professional Competence       This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r         Introduction       Introduction         Combinational logic: Gates, Boolean algebra, combinational networks       Sequential logic: Flip-flops, automata, systematic ha Technological foundations         Knowledge       Sequential logic: Flip-flops, automata, systematic ha Technological foundations         Computer arithmetic: Integer addition, subtraction, r         Basics of computer architecture: Programming pipelining         Memories: Memory hierarchies, SRAM, DRAM, caci Input/output: I/O from the perspective of the CPU connections, busses         The students perceive computer systems from the architect structure and the physical composition of computer syste specific and individual computers can be built based on a They are able to distinguish between and to explain computing systems - from gates and circuits up to complete Skills         After successful completion of the module, the students between a physical computer system and the software understand the consequences that the execution of software layers from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.         Personal Competence Social Competence       Students are able to acquire new knowledge from specific with other classes.         Workload in Hours       Independent Study Time 124, Study Time in Lecture 56	it is granted a bo examination's ma	onus on the rks are lifted	examinatior
CompetenceThis module deals with the foundations of the functionality from the assembly-level programming down to gates. The rIntroductionCombinational logic: Gates, Boolean algebra, combinational networksKnowledgeKnowledgeKnowledgeKnowledgeKnowledgeComputer arithmetic: Integer addition, subtraction, rBasics of computer architecture: Programming pipeliningMemories: Memory hierarchies, SRAM, DRAM, caci (Input/output: I/O from the perspective of the CPU connections, bussesThe students perceive computer systems from the architec structure and the physical composition of computer syste specific and individual computers can be built based on a They are able to distinguish between and to explain computing systems - from gates and circuits up to complete systems from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.Personal Competence Social CompetenceStudents are able to solve similar problems alone or in a gr Students are able to acquire new knowledge from specific with other classes.Workload in HoursIndependent Study Time 124, Study Time in Lecture 56	ollowing learning	results	
This module deals with the foundations of the functionality from the assembly-level programming down to gates. The r• Introduction• Combinational logic: Gates, Boolean algebra, combinational networks• Sequential logic: Flip-flops, automata, systematic ha • Technological foundations• Computer arithmetic: Integer addition, subtraction, r• Basics of computer architecture: Programming pipelining• Memories: Memory hierarchies, SRAM, DRAM, caci • Input/output: I/O from the perspective of the CPU connections, bussesThe students perceive computer systems from the architec structure and the physical composition of computer syste specific and individual computers can be built based on a They are able to distinguish between and to explain computing systems - from gates and circuits up to completeSkillsAfter successful completion of the module, the students between a physical computer system and the software understand the consequences that the execution of software layers from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.Personal Competence Sudents are able to solve similar problems alone or in a grAutonomyStudents are able to acquire new knowledge from specific with other classes.Workload in HoursIndependent Study Time 124, Study Time in Lecture 56			
from the assembly-level programming down to gates. The r• Introduction• Combinational logic: Gates, Boolean algebra, combinational networks• Sequential logic: Flip-flops, automata, systematic ha • Technological foundations• Computer arithmetic: Integer addition, subtraction, r• Basics of computer architecture: Programming pipelining• Memories: Memory hierarchies, SRAM, DRAM, cacl• Input/output: I/O from the perspective of the CPU connections, bussesThe students perceive computer systems from the architect structure and the physical composition of computer syste specific and individual computers can be built based on a They are able to distinguish between and to explain computing systems - from gates and circuits up to completeSkillsAfter successful completion of the module, the students between a physical computer system and the software understand the consequences that the execution of software layers from the assembly language down to gates. This impact that these low abstraction levels have on an en feasible options.Personal Competence Social CompetenceStudents are able to solve similar problems alone or in a grStudents are able to acquire new knowledge from specific with other classes.Workload in HoursIndependent Study Time 124, Study Time in Lecture 56			
Social Competence       Students are able to solve similar problems alone or in a gradient of a competence         Autonomy       Students are able to acquire new knowledge from specific with other classes.         Workload in Hours       Independent Study Time 124, Study Time in Lecture 56	Boolean function ardware design multiplication and models, MIPS ches J, principles of p ct's perspective, i. ems. The student a collection of few the different ab- e processors. s are able to jud e executed on i vare has on the has s way, they will b	ons, hardw I division single-cycl assing data e., they ider is can analy w and simpl straction lay lige the inte t. In particu ardware-cer ie enabled f	e architectur , point-to-poi htify the intern ze, how high e componen yers of today rdependencie ular, they sha ttric abstractio to evaluate th
Students are able to acquire new knowledge from specific         Autonomy         with other classes.         Workload in Hours         Independent Study Time 124, Study Time in Lecture 56			
Autonomy       with other classes.         Workload in Hours       Independent Study Time 124, Study Time in Lecture 56	proup and to prese	ent the resul	is accordingly
	ic literature and to	o associate	this knowledg
•			
Examination Written exam			
Examination duration 90 minutes, contents of course and labs			

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

## TUHH

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



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



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

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



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



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



Courses				
Title		Тур	Hrs/wk	СР
	tial Differential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Differential Equations) (L1044)		Recitation Section (small)	1	1
	tial Differential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038) Complex Functions (L1041)		Lecture Recitation Section (small)	2 1	1
Complex Functions (L1047)		Recitation Section (large)	1	1
Module Responsible		(alge)		•
Admission				
Requirements				
Recommended Previous Knowledge	Mathematics 1 - III			
Educational Objectives	After taking part successfully, students have	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples.</li> <li>Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.</li> <li>They know proof strategies and can reproduce them.</li> </ul>			
Skills	<ul> <li>Students can model problems in Mathematics IV with the help of the concepts studied in the course. Moreover, they are capable of solving them by applying established methods.</li> <li>Students are able to discover and verify further logical connections between the concept studied in the course.</li> <li>For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to work together in teams. They are capable to use mathematics as common language.</li> <li>In doing so, they can communicate new concepts according to the needs of their cooperatin partners. Moreover, they can design examples to check and deepen the understanding of the peers.</li> </ul>			
Autonomy	<ul> <li>Students are capable of checking t can specify open questions precise</li> <li>Students have developed sufficient oriented manner on hard problems.</li> </ul>	ly and know where to get help it persistence to be able to work	n solving the	m.
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	erential Equations 2)		



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

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



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

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

Course L1038: Complex Functions			
Тур	Lecture		
Hrs/wk	2		
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Main features of complex analysis</li> <li>Functions of one complex variable</li> <li>Complex differentiation</li> <li>Conformal mappings</li> <li>Complex integration</li> <li>Cauchy's integral theorem</li> <li>Cauchy's integral formula</li> <li>Taylor and Laurent series expansion</li> <li>Singularities and residuals</li> <li>Integral transformations: Fourier and Laplace transformation</li> </ul>		
Literature	<ul> <li>http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html</li> </ul>		



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

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



Module M0960: N Systems)	lechanics IV (Kinetics II, Oscillations, Analytical Me	chanics,	Multibody
Courses			
Title	Тур	Hrs/wk	СР
(L1137)	Oscillations, Analytical Mechanics, Multibody Systems)	3	3
(L 130)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small)	2	2
Mechanics IV (Kinetics II, (L1139)	Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large)	1	1
Module Responsible			
Admission Requirements	None		
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III		
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional			
Competence			
	The students can		
Knowledge	<ul> <li>describe the axiomatic procedure used in mechanical contexts;</li> <li>explain important steps in model design;</li> <li>present technical knowledge.</li> </ul>		
	The students can		
Skills	<ul> <li>explain the important elements of mathematical / mechanical analysis and model 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 other to overcome difficu	ulties.	
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84		
Credit points	6		
Examination	Written exam		
Examination duration and scale	120 min		
	General Engineering Science (German program): Specialisation	Mechanical	Engineerin
	Compulsory General Engineering Science (German program): Specialisation Biomedica	l Engineerin	a Compulse
	General Engineering Science (German program): Specialisation Biomedica General Engineering Science (German program): Specialisation Naval Arcl General Engineering Science (German program, 7 semester): Specialisatio Compulsory	hitecture: Co	mpulsory
	General Engineering Science (German program, 7 semester): Specialisatio Compulsory	on Biomedica	al Engineerin
	General Engineering Science (German program, 7 semester): Speciali Compulsory	isation Nava	al Architectur
Assignment for the	General Engineering Science (English program): Specialisation Mechanica General Engineering Science (English program): Specialisation Biomedica General Engineering Science (English program): Specialisation Naval Arch	l Engineerin iitecture: Cor	g: Compulsor npulsory
Following Curricula			gcom



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

Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	<ul> <li>Simple impact problems</li> <li>Principles of analytical mechanics</li> <li>Elements of vibration theory</li> <li>Vibration of Multi-degree of freedom systems</li> <li>Multibody Systems</li> </ul>
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009) D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011) W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).

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



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



Courses				
Title	Тур		Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)	Lecture Recitation	n Section (large)	3 2	4 2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering	g mechanics and	d thermodyn	amics.
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning	results	
Professional Competence	~			
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineerin and physics of fluids. Students can scientifically outline the rationale of flow physics usin mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculation for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly devel	lop solution strat	egies.	
Autonomy	The students are able to develop solution strategies for cor analyse results.	nplex problems	self-consiste	ent and crtica
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory			



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

Course L0454: Fluid Med	chanics		
Тур	ecture		
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 Med	ourse L0455: Fluid Mechanics	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	



Module M0640: Sto	ochastics and Ship Dynamics			
Courses				
Title		Тур	Hrs/wk	CP
Ship Dynamics (L0352)		Lecture Recitation Section (small)	2	3 1
Ship Dynamics (L1620) Statistics and Stochastic P	rocesses in Naval Architecure and Ocean Engineering	Recitation Section (Small)	1	I
(L0364)		Lecture	2	3
Module Responsible	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Technical mechanics</li> <li>Linear algebra, analysis, complex numbers</li> <li>Fluid mechanics</li> </ul>	i		
Educational Objectives	After taking part successfully, students have reache	ed the following learning	results	
Professional Competence				
Composition	- The students are able to give an overview ove		They can na	ame applicatio
	goals and they can describe the procedure of the n	nanoeuvres.		
	- The students are able to give an overview over rudder design.	varius rudder types. The	ey can nam	ie criteria in th
Knowledge	- The students can name computation methods v waves.	which are used to deterr	nine forces	and motions
	<ul> <li>The students can come up with the equations of n can use and linearise them.</li> <li>The students are able to determine hydrodynar</li> </ul>			
	meaning.			
Skills	- The students can explain how a rudder works a occur.	nd they can explain the	physical ef	fects which ca
	- The students can mathematically describe waves			
	- The students can explain the mathematically de can determine them.	escription of harmoncial	motions in v	waves and the
Personal Competence				
	- The students can arrive at work results in groups	and document them.		
Social Competence	- The students can discuss in groups and explain t	heir point of view.		
Autonomy	- The students can assess their own strengthes and weaknesses and the define further work steps or this basis.			
Workload in Hours	Independent Study Time 140, Study Time in Lectur	re 70		
Credit points	7			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program): General Engineering Science (German program Compulsory General Engineering Science (English program): S	n, 7 semester): Special	isation Nav	al Architectur



Following Curricula General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0352: Ship Dyn	amics
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships • Equations of motion • Hydrodynamic forces and moments • Linear equations and their solutions • Full-scale trials for evaluating the maneuvering performance • Regulations for maneuverability • Rudder Seakeeping • Representation of harmonic processes • Motions of a rigid ship in regular waves • Flow forces on ship cross sections • Strip method • Consequences induced by ship motion in regular waves • Behavior of ships in a stationary sea state • Long-term distribution of seaway influences
Literature	<ul> <li>Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik 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
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Тур	Lecture		
Hrs/wk	2		
CP			
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 fü Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014</li> <li>W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001</li> <li>H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3<sup>rd</sup> Edition John Wiley &amp; Sons, Inc., New York, NY, 2009</li> <li>ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011</li> <li>F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability and 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: Co	omputational Fluid Dynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynami		Lecture	2	3
Computational Fluid Dynami		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous Knowledge	<ul> <li>Mathematical Methods for Engineers</li> <li>Fundamentals of Differential/integral</li> </ul>		S	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence Knowledge	The students are able to list the basic numer	ics of partial differential equatic	ons.	
Skills	The students are able develop appropriate partial differential equations. They can code			-
Personal Competence Social Competence	The students can arrive at work results in gro	oups and document them.		
Autonomy	The students can independently analyse ap	proaches to solving specific pro	blems.	
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	2h			
-	General Engineering Science (German p Energy Systems: Compulsory General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Focus Energy Systems: Elective Compulsory General Engineering Science (English prog General Engineering Science (English prog Scous Energy Systems: Elective Compulsory Naval Architecture: Core qualification: Comp Technomathematics: Specialisation III. Engin	gram): Specialisation Naval Arch rogram, 7 semester): Specialisation (ram, 7 semester): Specialisation (ram): Specialisation Naval Arch rogram): Specialisation Mecha rogram, 7 semester): Specialisation (ram, 7 semester): Specialisation (ram, 7 semester): Specialisation	nitecture: Co isation Nav on Mechanic nitecture: Co anical Engi sation Nav on Mechanic	ompulsory al Architecture cal Engineering mpulsory neering, Focu al Architecture



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

ourse L0419: Computa	urse L0419: Computational Fluid Dynamics I	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Ship Struct	tural Design (10411)	Lecture	2	2
Fundamentals of Ship Struct		Recitation Section (small)	1	2
Fundamentals of Ship Struct		Lecture	2	2
Fundamentals of Ship Struct		Recitation Section (small)	1	2
Module Responsible	Prof. Sören Ehlers			
Admission				
Requirements				
Recommended	Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I			
Previous Knowledge	Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence				
	Students can reproduce the basic contents of the structural behaviour of ship structures; they c explain the theory and methods for the calculation of deformations and stresses in beam-l structures.			-
Knowledge	Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished produce joining and principles of structural design of components in the ship structure.		ished produc	
Skills	Students are capable of applying the methods and tools for the calculation of linear deformations an stresses in the above mentioned structures; they can choose calculation models of typical sh structures. Furthermore, they are capable to apply the methods of drawing and sizing the ship structure; they can select suitable materials, semi-finished products and joints.			
Personal Competence				
Social Compotence	The students are able to communicate and cooperate in a professional environment in the			
Social Competence	shipbuilding and component supply indust	у.		
	The students are capable to independently idealize real ship structures and to select suitable methor for analysis of beam-like structures; they are capable to assess the results of structural analyses.			
Autonomy	Furthermore, they are capable to assess drawings of complex ship structures and to design sh structures for various requirements and boundary conditions.			
Workload in Hours	Independent Study Time 156, Study Time in	Lecture 84		
Credit points				
-	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory			



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Naval Architecture: Core qualification: Compulsory

ourse L0411: Fundamentals of Ship Structural Design	
Тур	Lecture
Hrs/wk	2
CP	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

ourse L0413: Fundamentals of Ship Structural Design	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Chapters: 1. Introduction 3. Class societies and their tasks 4. Materials for steel shipbuilding 5. Welding and Cutting 6. Semi-finished products in steel shipbuilding 7. Determining the scantlings for local loads 8. Longitudinal strength of the hull girder 9. Determining the scantlings of longitudinal structural members 10. Determining the scantlings of bottom and side structures 11. Decks and Hatch Openings 12. Effective breadth 13. Iterative determination of scantlings (POSEIDON)
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht



Course L0410: Fundame	ourse L0410: Fundamentals of Ship Structural Analysis		
Тур	Lecture		
Hrs/wk	2		
CP	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	

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Module M0664: Str	ructural Design and Construction o	f Ships		
Courses				
Title Ship Structural Design (L04 Ship Structural Design (L04 Welding Technology (L1123	15)	<b>Typ</b> Lecture Recitation Section (small) Lecture	Hrs/wk 2 2 3	CP 3 3 3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence		s well as fabrication of t	ha difforant	aroas of ship
Knowledge	Students can reproduce design and sizing as well as fabrication of the different areas of ship structures and of different ship types (incl. detail design); they can describe calculation models for complex structures.			
Skills	Students are capable to specify the requirements for different ship types and areas of the hull, to define design criteria for the components, to select suitable calculation models and to assess the chosen structure			
Personal Competence Social Competence	Students are capable to present their structural design and discuss their decisions constructively in a		nstructively in a	
Autonomy	Students are capable to design independently different structural areas of the ship hull and different ship types and to define appropriate fabrication methods.			
Workload in Hours	Independent Study Time 172, Study Time in Lect	ure 98		
Credit points				
	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula				



Course L0412: Ship Structural Design		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	SoSe	
Content	Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	

ourse L0415: Ship Structural Design	
Тур	Recitation Section (small)
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



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



Module M1109: Re	sistance and Propulsion			
Courses				
Title Resistance and Propulsion ( Resistance and Propulsion (		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	<ul> <li>Mechanics</li> <li>Fluid Dynamics for Naval Architects</li> <li>Hydrostratics</li> </ul>			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmenta additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fue consumption. The following topics are dealt with: - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation Appendage Design and resistance, Froude's resistance law,form factor method, thrust deduction wake, model scaling laws, resistance tests, free running propeller tests and propeller basics propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims			
Skills	The student shall learn to design competitve hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences.			
Personal Competence				
Social Competence	The student learns to prepare technical matters suvervision team.	in such a way that he ca	an compte v	vith his building
Autonomy	The student learns to prepare technical matters in such a way that he can compte with his building suvervision team.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula				



Course L1265: Resistan	course L1265: Resistance and Propulsion		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Stefan Krüger		
Language	DE		
Cycle	WiSe		
Content			
Literature			

Course L1266: Resistan	Irse L1266: Resistance and Propulsion			
Тур	Recitation Section (large)			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Stefan Krüger			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

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Module M1118: Hydrostatics and Body Plan					
Courses					
Title		Тур	Hrs/wk	СР	
Hydrostatics (L1260)		Lecture	2	3	
Hydrostatics (L1261)		Recitation Section (large)	2	1	
Body Plan (L1452)		Project Seminar	2	2	
Module Responsible	Prof. Stefan Krüger				
Admission Requirements	None				
	Good knowledge in Mathemathics I-III and Mech	anics I-III.			
Recommended Previous Knowledge	I It is recommended that the students are tamiliar with typical design relevant drawings, e.g. Rody Plar				
Educational Objectives	After taking part successfully, students have read	ched the following learning	results		
Professional					
Competence					
Knowledge	The lecture enables the student to carry out all necessary theoretical calculations for ship design on scientific level. The lecture is basic requirement for all following lectures in the subjects shipo desig and safety of ships.				
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					
-	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Examination	Written exam				
Examination duration and scale	1180 min				
Assignment for the Following Curricula					

Course L1260: Hydrostatics		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
	<ol> <li>Numerical Integration, Diffrentation, Interpolation</li> <li>Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods</li> <li>Determination of Areas, 1st and 2nd order Moments</li> <li>Numerical Diffrentation, Spline Interpolation</li> </ol>	

# TUHH

#### 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
Literature	Fachbuchverlag Leipzig 2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin
	3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.
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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

Тур	Project Seminar		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Stefan Krüger		
Language	DE		
Cycle	WiSe		
	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		
Content	- 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.		
	1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig		
Literature	2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin		
	3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.		



Module M0933: Fu	ndamentals of Materials Science			
-				
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S		Lecture	2	2
Fundamentals of Materials Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	tics		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional				
Competence				
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and car describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.			
Skills	The students are able to trace materials phenom laws of nature. Materials phenomena here refers and stiffness, chemical properties such as corrosid solidification, precipitation, or melting. The stud conditions and the materials microstructure, and t the material's behavior.	to mechanical properties on resistance, and to pha ents can explain the rel	such as str se transform ation betwe	ength, ductilit nations such a en processin
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lecture	84		
Credit points				
-	Written exam			
Examination duration and scale	 180 min			
	 General Engineering Science (German prog	ram): Specialisation E	nergy and	Enviroment
	Engineering: Compulsory	, 1	0,	
	General Engineering Science (German pro	gram): Specialisation	Mechanical	Engineering
	Compulsory General Engineering Science (German program):	Specialisation Riomodica	l Engineerir	na: Compulso
	General Engineering Science (German program): General Engineering Science (German program, 7	Specialisation Naval Arch	nitecture: Co	mpulsory
	Compulsory General Engineering Science (German program, 7	7 semester): Specialisatio	on Biomedic	al Engineering
	Compulsory General Engineering Science (German progran Compulsory			
	General Engineering Science (German prog Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core qua		pecialisation	Energy an



Assignment for the Following Curricula	Engineering: (Computeeriv	
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 Enviromental	
	Engineering: Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory	
	Mechanical Engineering: Core qualification: Compulsory	
	Mechatronics: Core qualification: Compulsory	
	Naval Architecture: Core qualification: Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

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

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

1



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



Module M1110: Sh	ip Design			
Courses				
<b>Title</b> Ship Design (L1262) Ship Design (L1264)		<b>Typ</b> Lecture Recitation Section (large)	Hrs/wk 2 2	<b>CP</b> 3 3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements				
Recommended Previous Knowledge	· · · · · · · · · · · · · · · · · · ·	-		
Educational Objectives	After taking part successfully, students have re	eached the following learning	results	
Professional Competence				
	related technical risk are introduced. The most their influence on the competitiveness of a de main parameters on the total performance of this lecture, the design changes are dealt with learn to model complex systems properly so t	at important main parameters of esign. The lecture focusses or a ship design and the conse on by simple models or formula	of a ship are the influer cutive proce ae. The stuc	e introduced an nce of alternate ess elements. I lent shall furthe
	The lecture continues with an introduction in design phase to a building contract. Further, relevant information at different levens of gra following topics are adressed:	methods are introduced to ge	nerate buld	ling specficatio
Knowledge	<ul> <li>Structure of a building specification</li> <li>Determination of Light Ship Weight and Deal Components</li> <li>Design of main section and hull form</li> <li>Design of aftbody lines and manoevering deal Design of main propulsion plant</li> <li>Design of subdivision</li> <li>Determination of limiting GMrequ- Curves</li> <li>Scantlings of most improtant structural members</li> <li>Longitudinal strength</li> <li>Outfitting Components</li> <li>Relevant rules and regulations</li> </ul>	vices		
Skills	The student is made familiar with the basic design principles of seagoing mearchant ships. The goal of the lecture is that the student shall be able to carry out a concept design based on a vessel of comparison fulfilling typical contract requirements within the Marine Environment. The lecture deals with the basic design methods to determine the fundamantal technical characteristics of a ship design with respect to fulfillment procedures of the contract values. Based on the lecture "Principles of Ship Design" the relevant methods to determine and judge uopn the performance of a ship design are treated.			
Personal Competence				
Social Competence	The students learns to prepare technical ma customer against his competitors.			
Autonomy	The students learns to prepare technical m customer against his competitors.	atters in such a way the he	can persua	de his potantia
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Examination	Written exam			
Examination duration				



and scale	180 min
	General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture:

Course L1262: Ship Des	burse 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				
Title		Тур	Hrs/wk	СР
Introduction into Process Er Fundamentals of material er	ngineering/Bioprocess Engineering (L0829) ngineering (L0830)	Lecture Lecture	2 2	1 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	none			
<b>Educational Objectives</b>	After taking part successfully, students have	reached the following le	earning results	
Professional Competence				
Knowledge	nt fields on process and iferent fields in process		ering,	
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 document them,</li> <li>provide appropriate feedback and handle feedback on their own performance constructively.</li> </ul>			
Autonomy	The students are able to estimate their prog of knowledge in Process Engineering and B		nselves and to delib	perate their la



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

Course L0829: Introduction into Process Engineering/Bioprocess Engineering			
Тур	Lecture		
Hrs/wk	2		
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		



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



Module M0937: Ph	ysical 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 che	mistry, physics for engin	neers and mathe	ematics I-III.		
	After taking part successfully, students have read	ched the following learn	ning results			
Professional Competence						
	The students are able,					
	-to repeat the basic concepts of physical chemis	try				
Knowledge	-to describe and summarize the underlying conc	epts of mass-, heat- ar	nd momentum tra	ansfer.		
	- to interpret phase diagrams and affiliate kinetic rate laws.					
	The students are able to					
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.					
Skills	- assess new applications with respect to environmental sustainability.					
	- abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kinetic calculations.					
Personal Competence						
	The students are able to plan, prepare, conduct and document experiments according to scientific guidelines in small groups.					
Social Competence	The students are able to reflect their subject-specific knowledge orally in a team and to discuss it with fellow students and faculty.					
Autonomy	Students are able to assess their knowldege Students are able to apply their knowldege discr					
Workload in Hours	Independent Study Time 34, Study Time in Lectu	ıre 56				
Credit points						
Examination	Written exam					
Examination duration and scale	180 min					
-	General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulso General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory r the Bioprocess Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: 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 Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineerin					



Course L0833: Physical	Chemistry
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Hans-Ulrich Moritz, Dr. Werner Pauer
Language	DE
Cycle	WiSe
Content	State variables and state equations, ideal and real gases, first law, driving force of chemical reactions, chemical equilibria, introduction into kinetics of chemical reactions, introduction into 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>

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



Module M0730: Co	mputer Engineering			
Courses				
Title Computer Engineering (L032 Computer Engineering (L032		<b>Typ</b> Lecture Recitation Section (small)	<b>Hrs/wk</b> 3 1	<b>CP</b> 4 2
Module Responsible	Prof. Heiko Falk			
A device ion	None			
nequirements	Basic knowledge in electrical engineering			
Recommended Previous Knowledge	The successful completion of the labs will be honored during the evaluation of the module' examination according to the following rules:			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge Skills	<ul> <li>This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics:</li> <li>Introduction</li> <li>Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks</li> <li>Sequential logic: Flip-flops, automata, systematic hardware design</li> </ul>			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to pres	ent the result	s accordingly.
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points	6			
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			

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

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



Courses				
Title Fundamentals of Fluid Mech Fluid Mechanics for Proces:		<b>Typ</b> Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2	<b>CP</b> 4 2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning	g results	
Professional Competence				
Knowledge	<ul> <li>Students are able to:</li> <li>explain the difference between different types of flow</li> <li>give an overview for different applications of the Reynolds Transport-Theorem in process engineering</li> <li>explain simplifications of the Continuity- and Navier-Stokes-Equation by using physica boundary conditions</li> </ul>			
Skills	<ul> <li>The students are able to</li> <li>describe and model incompressible flows mathematically</li> <li>reduce the governing equations of fluid mechanics by simplifications to archive quantitativ solutions e.g. by integration</li> <li>notice the dependency between theory and technical applications</li> <li>use the learned basics for fluid dynamical applications in fields of process engineering</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>The students</li> <li>are capable to gather information from subject related, professional publications and relate tha 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>			
Autonomy	<ul> <li>The students are able to</li> <li>search further literature for each top</li> <li>work on their exercises by their own</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
	Written exam			
Examination duration and scale	3 hours			
	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engineering: Compulsory General Engineering Science (German p	ogram): Specialisation Bioproce n program): Specialisation	ss Engineeri Energy and	ng: Compulsor



Assignment for the Following Curricula	Energy and Environmental Engineering. Core qualification: Compulsory
	Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory

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



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



Courses				
<b>Title</b> Phase Equilibria Thermodyn Phase Equilibria Thermodyn Phase Equilibria Thermodyn	amics (L0140)	<b>Typ</b> Lecture Recitation Section (small) Recitation Section (large)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible		neonation dection (large)	•	L
Admission Requirements				
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermodynamics I and II			
Educational Objectives	After taking part successfully, students ha	we reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>Starting from the very basics of thermodynamics, the students learn the mathematical tools describe thermodynamic equilibria.</li> <li>They learn how state variables are influenced by the mixing of compounds and learn concept to quantitatively describe these properties.</li> <li>Moreover, the students learn how phase equilibria can be described mathematically and whice phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibriar Furthermore the fundamentals of reaction equilibria are taught.</li> <li>For different phase equilibria, several examples relevant for different kinds of processes and shown and the necessary knowledge for plotting and interpreting the equilibria are taught.</li> </ul>			
Skills	<ul> <li>Applying their knowledge, the students are able to identify the correct equation for determination of the equilibrium state and know how to simplify these equations meaningfull</li> <li>The students know models which can be used to determine the properties of the system in 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-chem 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 mixtures.</li> <li>The students know how to visualize phase equilibria graphically and they know how interpret the occurring phenomena.</li> <li>Based on their knowledge, the students are able to understand fundamental concepts that the basis for many separation and reaction processes in chemical engineering.</li> </ul>			
Personal Competence		groups to solve the correspondin	a probloma	and to proce
Social Competence	The students are able to work in small groups, to solve the corresponding problems and to prese them oraly to the tutors and other students			
Autonomy	<ul> <li>The students are able to find ne judge their quality.</li> <li>During the semester the student exercises. Based on this knowled</li> </ul>		g progress	continuously
Workload in Hours				



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

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



Course L0140: Phase Ec	uilibria Thermodynamics		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	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 Flu 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. (Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>		



Course L0142: Phase Ec	uilibria Thermodynamics	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	ndependent 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: equilibrium condition, Henry-coefficient</li> <li>G<sup>E</sup>-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC</li> <li>Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems</li> <li>Solid-liquid-equilibria: reaction coordinate, mass action law, influence of pressure and temperature</li> <li>Osmotic pressure</li> </ol>	
Literature	<ul> <li>Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992</li> <li>J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid- Phase Equilibria, 3rd ed. Prentice Hall, 1999.</li> <li>J.W. Tester, M. Modell: Thermodynamics and its Applications. 3<sup>rd</sup> ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.</li> </ul>	



period by solving tutoria	ith spectral tra- red. variant (LTI) s amental trans and analyse ticular, they un sition of a co near time-inva n basic syste earity etc The nain.	systems usin formations of determinist nderstand th ntinuous-tim ariant system ms regardin ey can asses ess. They ca	
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period by solving tutoria			
period by solving tutoria			
period by solving tutoria			
56		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 tool clicker system.	
	Independent Study Time 124, Study Time in Lecture 56		
<ul> <li>becialisation Bioprocess</li> <li>am): Specialisation</li> <li>am): Specialisation</li> <li>becialisation Biomedica</li> <li>semester): Specialisation</li> <li>7 semester): Specialisation</li> <li>7 semester): Specialisation</li> <li>semester): Specialisation</li> <li>semester): Specialisation</li> </ul>	Science: Corr ngineering: Co s Engineering Civil- and Mechanical Il Engineering tion Electrical sation Completion Process on Bioprocess on Bioprocess	npulsory ompulsory :: Compulso Enviroment Engineerin :: Compulso Engineerin uter Scienc Engineerin Engineerin Engineerin	
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1	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
Accierment for the	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering:
	Compulsory
	General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Computer Science: Compulsory
	General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



rse L0432: Signals a	nd 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 a	ourse L0433: Signals and Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Gerhard Bauch		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		



Courses				
Title		Тур	Hrs/wk	СР
Bioprocess Engineering - Fu	Indamentals (L0841)	Lecture	2	3
Bioprocess Engineering- Fu		Recitation Section (large)	2	1
Bioprocess Engineering - Fu	Indamental Practical Course (L0843)	Practical Course	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	none, module "organic chemistry", module	e "fundamentals for process eng	ineering"	
Educational Objectives	After taking part successfully, students have	ve reached the following learnin	g results	
Professional				
Competence				
Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to classi different types of kinetics for enzymes and microorganisms, as well as to differentiate different types inhibition. The parameters of stoichiometry and rheology can be named and mass transport processe in bioreactors can be explained. The students are capable to explain fundamental bioproces management, sterilization technology and downstream processing in detail.			
Skills Personal Competence Social Competence Autonomy	<ul> <li>After successful completion of this module</li> <li>describe different kinetic approad corresponding parameters</li> <li>predict qualitatively the influence of growth inhibition on the fermentati</li> <li>analyze bioprocesses on basis of</li> <li>distinguish between scale-up critical aerobic as well as microaerobic biotechnical problem</li> <li>propose solutions to complicated models</li> <li>to explore new knowledge resource</li> <li>identify scientific problems with co</li> <li>to document and discuss their provide</li> </ul>	ches for growth and substrate- of energy generation, regeneration on process stoichiometry and to set up / solveria for different bioreactors and biotechnological problems and ces and to apply the newly gained ncrete industrial use and to form cedures as well as results in a substrate sition to their own opinions an vironments.	tion of redox we metabolic and bioproces as to apply to to deduce the ed contents nulate solution cientific mann technical que d increase the echnical prol	equivalents ar flux equations ses (anaerobi hem to curre e correspondir ns. ner
Workload in Hours	Independent Study Time 96, Study Time in	n Lecture 84		
Credit points	i			
-	Written exam			
Examination duration				
	General Engineering Science (German pr General Engineering Science (German pr General Engineering Science (German Compulsory General Engineering Science (German p	ogram): Specialisation Bioproce program, 7 semester): Speciali	ess Engineeri sation Proce	ng: Compulso ss Engineerin



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

Course L0841: Bioproce	ss 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 o yield, theoretical oxygen demand (Prof. Liese)</li> <li>Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng)</li> <li>Kinetic of subtrate consumption and product formation (Prof. Zeng)</li> <li>Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese)</li> <li>Transport process in a bioreactor (Prof. Zeng)</li> <li>Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese)</li> <li>Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese)</li> </ul>
Literature	<ul> <li>K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH 2012</li> <li>H. Chmiel: Bioprozeßtechnik, Elsevier, 2006</li> <li>R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010</li> <li>H.W. Blanch, D. Clark: Biochemical Engineering, Taylor &amp; Francis, 1997</li> <li>P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013</li> </ul>



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
Content	<ol> <li>Introduction (Prof. Liese, Prof. Zeng)</li> <li>Enzymatic kinetics (Prof. Liese)</li> <li>Stoichiometry I + II (Prof. Liese)</li> <li>Microbial Kinetics I+II (Prof. Zeng)</li> <li>Rheology (Prof. Liese)</li> <li>Mass transfer in bioprocess (Prof. Zeng)</li> <li>Continuous culture (Chemostat) (Prof. Zeng)</li> <li>Sterilisation (Prof. Zeng)</li> <li>Downstream processing (Prof. Liese)</li> <li>Repetition (Reserve) (Prof. Liese, Prof. Zeng)</li> </ol>
Literature	siehe Vorlesung

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



Module M0538: He	at and Mass Transfer			
Courses				
<b>Title</b> Heat and Mass Transfer (L0 Heat and Mass Transfer (L0 Heat and Mass Transfer (L1	0102)	<b>Typ</b> Lecture Recitation Section (small) Recitation Section (large)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible			•	L
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge: Technical Thermodyna	mics		
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>The students are capable of expla procedural apparatus (e.g. heat e.</li> <li>They are capable of distinguish a namely heat conduction, heat trans</li> <li>The students have the ability to e describe mass transfer qualitative</li> <li>They are able to depict the analog linked processes in detail.</li> </ul>	xchanger, chemical reactors). Ind characterize different kinds o sfer and thermal radiation. Explain the physical basis for ma and quantitative by using suitable	f heat transf ss transfer mass trans	fer mechanism in detail and t fer theories.
Skills	<ul> <li>The students are able to set reas using the gained knowledge ar respectively.</li> <li>They are capable to solve specitemperature alteration in fluids) an</li> <li>Using dimensionless quantities, the apparatus.</li> <li>They are able to distinguish between the transmission of the transmission of</li></ul>	nd to balance the correspondin ific heat transfer problems (e.g. id to calculate the corresponding h ne students can execute scaling u een diffusion, convective mass tr ir the description and design of apable to choose and design fun- oplication considering their advan n, steady-state and non-steady-sta- nect their knowledge obtained in t e courses thermodynamics, fluid	g energy a heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate processe his course	and mass flow emical reactors cal processes of d mass transfe (e.g. extraction pes of heat an disadvantages es in procedura with knowlegd
Personal Competence Social Competence	<ul> <li>The students are capable to work results orally in a reasonable man</li> </ul>		n teams and	d to present th
	<ul> <li>The students are able to find and e</li> <li>They are able to prove their le procedure continuously (clicker-s</li> </ul>	evel of knowledge during the c	ourse with	accompanyin



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



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

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

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

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Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Process	ses (L0118)	Lecture	2	2
Thermal Separation Process		Recitation Section (small)	2	2
Thermal Separation Process	ses (L0141)	Recitation Section (large)	1	1
Separation Processes (L115	59)	Practical Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodyna	mics III		
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	<ul> <li>distillation, extraction, and adsorptio</li> <li>The students develop an understar process, the estimation of the energy and the selection of separation syste</li> <li>They have good knowledge of design</li> </ul>	nding for the course of concer y demand of a process, the po ems	ssibilities of	energy savin
Skills	<ul> <li>Using the gained knowledge the stusseparation process and can close th</li> <li>The students can use different graphing and define the amount of theoretical</li> <li>They can select and design a basic on the advantages and disadvantag</li> <li>The students are capable to obtain appropriate sources (diagrams and the students are able to prove their)</li> <li>The students are able to discusse the students are able to discusse the students are capable of linking their graphic together for the solution of technical properties and chemical engineering.</li> </ul>	e associated energy and mater ohical methods for the designi stages required type of thermal separation proc es of the process ain independently the needer tables) discontinuous processes theoretical knowledge in the ex s the theoretical background in colloquium.	ial balances ng of a sep cess for a gir d material perimental I d and the nt of other Ia	aration proce ven case base properties fro ab work. content of th ectures and u
Personal Competence	The students can work technical a	assignments in small groups	and presen	t the combine
Social Competence	<ul> <li>results in the tutorial</li> <li>The students are able to carry out p division of labor between them. The scientifically in a report.</li> </ul>		-	
Autonomy	<ul> <li>The students are capable to ob themselves and assess their quality</li> <li>The students can proof the state of this way control their learning procest</li> </ul>	heir knowledge with exam rese		



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



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



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



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



	Hrs/wk	СР	
	2	2	
n (large)		2	
	2	2	
None			
		modynamics	
learning	ig results		
The students are able to explain basic concepts of chemical reaction engineering. They are able point out differences between thermodynamical and kinetical processes. The students have a stro ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their propertie After successful completion of the module, students are able to:			
- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,			
Skills - determine and compute stable operation points for these reactors , - conduct experiments on a lab-scale pilot plants and document these according to guidelines.			
After successful completition of the lab-course the students have a strong ability to organi themselfes in small groups to solve issues in chemical reaction engineering. The students can discu their subject related knowledge among each other and with their teachers.			
	ance autonoi	nously. Stude	
lioproce Specialis ecialisat	ess Engineer isation Proce tion Bioproce	: Compulsory ring: Compuls ess Engineeri ess Engineeri	
rocess E Specialis	Engineering sation Proce	ess Engineeri	
roc Spe	ess ciali	alisation Bioproce	

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



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



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

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



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



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



Courses				
Title         Practical Course: Measurement and Control Systems (L1119)         Measurement Technology for Mechanical and Process Engineers (L1116)         Measurement Technology for Mechanical and Process Engineers (L1118)		<b>Typ</b> Practical Course Lecture Recitation Section (large)	<b>Hrs/wk</b> 2 2 1	<b>CP</b> 2 3 1
Module Responsible				
A durie e ie n	None			
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and ele	ectrical engineering		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
	Students are able to name the most imp (Quantities and Units, Uncertainty, Calibrati Systems).			
Knowledge	They can outline the most important meas maesured (Electrical Quantities, Temperature,	-		
	They can describe important methods of Chromatography)	chemical Analysis (Gas Se	ensors, Spe	ctroscopy, G
Skills	Students can select suitable measuring methods to given problems and can use referin 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	Students can arrive at work results in groups a	nd document them in a comr	non report.	
Social Competence				
	Students are able to familiarize themselves wit		ogies.	
	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points Examination				
Examination duration and scale	105 minutes			
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra	program): Specialisation m): Specialisation Biomedica m): Specialisation Process E program, 7 semester): Sp m, 7 semester): Specialisation am, 7 semester): Specialisation ram, 7 semester): Specialisation	Mechanica al Engineeri ingineering: pecialisation on Mechanic on Biomedic	I Engineerir ng: Compulsor Compulsory n Energy a cal Engineerir cal Engineerir
	Energy and Environmental Engineering: Core	qualification: Compulsory		



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



Course L1119: Practical	Course: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
CP	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
	<ul> <li>Versuch 1:</li> <li>Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974</li> <li>Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979</li> <li>Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung</li> <li>Gebrauchs- und Bedienungsanweisungen</li> <li>VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1</li> </ul>
Literature	<ul> <li>Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren</li> <li>Simulationsmethoden, speziell: Verwendung von Blockschaltbildern</li> <li>Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze</li> <li>Versuch 3:</li> <li>Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984</li> <li>Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988</li> <li>Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989</li> </ul>
	<ul> <li>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>



ourse L1116: Measure	ment Technology for Mechanical and Process Engineers
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Krause
Cycle	
	1 Fundamentals
	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
Content	2.6 Data Transmission
Content	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle
	3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
	4 Chemical Analysis
	4.1 Gas Sensors
	4.2 Spectroscopy
	4.3 Gas Chromatography
	At the end of each lecture students present single measuring techniques and results orally in front the class.
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3.
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 97 3486217940.



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

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Courses				
Title Introduction to Control Syste		<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk 2 2	<b>CP</b> 4 2
Module Responsible			_	_
Admission				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform			
Educational Objectives	After taking part successfully, students	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 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 i terms of frequency response and root locus</li> <li>They can explain the Nyquist stability criterion and the stability margins derived from it.</li> <li>They can explain the role of the phase margin in analysis and synthesis of control loops</li> <li>They can explain the way a PID controller affects a control loop in terms of its frequency response</li> <li>They can explain issues arising when controllers designed in continuous time domain ar implemented digitally</li> </ul>			
Skills	<ul> <li>Students can transform models of linear dynamic systems from time to frequency domain and vice versa</li> <li>They can simulate and assess the behavior of systems and control loops</li> <li>They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules</li> <li>They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques</li> <li>They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation</li> <li>They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks</li> </ul>			
Personal Competence				
Social Competence	Students can work in small groups t	to jointly solve technical problems, a	and experim	entally validat
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.			
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points				
-	Written exam			
Examination duration and scale				
	General Engineering Science (Germa General Engineering Science (Gerr Compulsory General Engineering Science (Germa	nan program, 7 semester): Special	isation Com	

Computery Comput		Compulsory
Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical 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 Alicraft Systems Engineering: Compulsory General Engineering Science: German program, 7 semester): Specialisation Mechanical Engineering Focus Alicraft Systems Engineering: Compulsory General Engineering Science: German program, 7 semester): Specialisation Mechanical Engineering Focus Hoteristal 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 Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineering: Compul		
Computery General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Computery General Engineering Science (English program, 7 semester): Specialisation Computery General Engineering Science (English program, 7 semester): Specialisation Computery General Engineering Science (English program, 7 semester): Specialisation Computery General Engineering Science (English program, 7 semester): Specialisation Crowesters Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Computery General Engineering Science (English program, 7 semester): Specialisation Nechanical Engineeri		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Focus Mechanonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Machanolis: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Matchanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Matchanis in Engineering Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Energy Systems: Compulsory</li> <li>Bioprocess Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Rouped Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Archi</li></ul>		
<ul> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Focus Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrat Systems Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Provetical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (German program, 7 semester): Specialisation Mechanical Engineering; Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Enviromental Engineering: Compulsory</li> <li>General Engi</li></ul>		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Ecous Mechatonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Ecous Biomechics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Ecous Mechanica: Engineering, Ecous Aircraft Systems Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory</li> <li>General Engineering Cone qualification: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Eng</li></ul>		
<ul> <li>Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Michatonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Michatonics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Micrat Systems Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Micratis in Engineering: Science: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Forotical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Forotical Mechanical Engineering: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering: Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Environmental Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester</li></ul>		
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 Mechanonics: Compulsory General 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 Micraft Systems Engineering: Compulsory General 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 Finergi Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energi Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Finergi Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energi Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Finergy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Floriving Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Floriving Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Florivinemental Engineering; Science (English program, 7 semester): Specialisation Florivinemental Engineering; Science (English program, 7 semest		
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Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrat Bystems Engineering, Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrati Systems Engineering, Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrati Systems Engineering, Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micratical Engineering: 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 Energy Systems: Compulsory Computer Science: Specialisation Compulsory Computer Science: Specialisation Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computery Computer Science: Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Computery General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program,		
<ul> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanics: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering; Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science, Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Science, Compulsory</li> <li>General Engineering Science, Compulsory</li> <li>General Engineering Science, Compulsory</li> <li>General Engineering Science, Compulsory</li> <li>General Engineering, Science, Compulsory</li> <li>General Engineering Science, Compulsory</li> <li>General Engineering, Compulsory</li> <li>Computer Science: Science, Science, Compulsory</li> <li>Bioprocess Engineering, Compulsory</li> <li>General Engineering, Science (English program, 7 semester): Specialisation Mechanical Engineering, Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory</li> <li>General Engine</li></ul>		
Focus Mechatonics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Endout Development and Production: Compulsory General Engineering Core qualification: Compulsory Energy and Environmental Engineering, Core qualification: Compulsory Energy and Environmental Engineering, Core qualification: Compulsory Energy and Environmental Engineering, Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Environmental Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engine		
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 Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectures Compulsory General Engineering Science (English program, 7 semester): Specialisation Ieutrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester):		
Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircratt Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Davelopment and Production: Compulsory General Engineering: Compulsory General Engineering: Compulsory General Engineering: Compulsory General Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering		
Focus Aircritt Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory Electrical Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Iectrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanicis: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mec		
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 General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program): Core qualification Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Focus Mechanical: Compulsory General Enginee		
<ul> <li>Focus Materials in Engineering Sciences: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering, Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>Computer Science: Specialisation Computational Mathematics: Elective Compulsory</li> <li>Electrical Engineering: Core qualification: Compulsory</li> <li>General Engineering Science (English program): Core qualification: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsor</li></ul>		
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<ul> <li>Focus Theoretical Mechanical Engineering: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory</li> <li>General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>Computer Science: Specialisation Compulsory</li> <li>General Engineering: Core qualification: Compulsory</li> <li>Electrical Engineering Science (English program, 7 semester): Specialisation Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Process Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering;</li> <li>Compulsory</li> <li>General Engineering Science (English program, 7 semester): Specialisation M</li></ul>		
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Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
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Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory		



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

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



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



Courses				
Title		Тур	Hrs/wk	СР
Practical Exercise Environmental Technology (L1387) Environmental Technologie (L0326)		Practical Course Lecture	1 2	1 2
Module Responsible	Dr. Joachim Gerth			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of inorganic/organic	chemistry and biology		
Educational Objectives	After taking part successfully, studer	nts have reached the following learn	ing results	
Professional Competence				
	With the completion of this modul the students obtain profound knowledge of environment technology. They are able to describe the behaviour of chemicals in the environment. Students ca give an overview of scientific disciplines involved. They can explain terms and allocate them to relate methods.			
Skills	Students are able to propose appropriate management and mitigation measures for 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 defent these opinons in front of and against the group.			
Personal Competence				
	The students are able to discuss the various technical and scientific tasks, both subject-specific an			
	Students can independently exploit tranfer it to new problems.	sources about of the subject, acquir	e the particular	knowledge ar
Workload in Hours	Independent Study Time 48, Study	Time in Lecture 42		
Credit points	3			
Examination	Written exam			
Examination duration and scale	1 hour			
Assignment for the Following Curricula	TENENOVANO ENVIRONMENIAI ENRINEENING. GOLE ODAMICANON, GOMOUISOIV			

## Process Engineering: Core qualification: Elective Compulsory

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Course L1387: Practical Exercise Environmental Technology				
Тур	Practical Course			
Hrs/wk				
СР				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Dr. Joachim Gerth			
Language	DE			
Cycle	SoSe			
Content	The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc an obosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces modified by the application of salt. This has consequences for the retention of nutrients and pollutant 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-specif and multidisciplinary. They discuss different approaches to the task as well as it's theoretical operactical 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: Environmental Technologie			
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta		
Language	DE		
Cycle	WiSe		
Content	<ol> <li>Introductory seminar on environmental science:</li> <li>Environmental impact and adverse effects</li> <li>Wastewater technology</li> <li>Air pollution control</li> <li>Noise protection</li> <li>Waste and recycling management</li> <li>Soil and ground water protection</li> <li>Renewable energies</li> <li>Resource conservation and energy efficiency</li> </ol>		
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972- 5 (ISBN)		

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Courses				
Title         Process and Plant Engineering I (L0095)         Process and Plant Engineering I (L0096)         Process and Plant Engineering I (L1214)		<b>Typ</b> Lecture Recitation Section (large) Recitation Section (small)	<b>Hrs/wk</b> 2 1 1	<b>CP</b> 2 2 2
Module Responsible				L
Admission				
Recommended	unit operation of thermal an dmechanical s	separation processes		
Educational Objectives	After taking part successfully, students hav	re reached the following learning	results	
Professional Competence	students can:			
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 - estimation of component streams of chen - solution of data reconcilliation tasks - conduction of process synthesis - economic evaluation of processes and th	nical plants using linear compone		
Personal Competence				
Social Competence				
Autonomy	Independent Study Time 104, Study Time	in Looturo EC		
Credit points	Independent Study Time 124, Study Time			
	Written exam			
Examination duration and scale	120 Min. lectures notes and books			
Assignment for the Following Curricula	General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German Enviromental Engineering: Elective Comp Bioprocess Engineering: Core qualification General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory	ogram): Specialisation Bioproces program, 7 semester): Specialisation ogram, 7 semester): Specialisation in program, 7 semester): Sp ulsory n: Compulsory ogram): Specialisation Bioprocess ogram): Specialisation Process Er program, 7 semester): Specialisation	s Engineeri ation Proces on Bioproce decialisation s Engineering ation Proces	ng: Compulso ss Engineerir ss Engineerir n Energy a ng: Compulso Compulsory ss Engineerir



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



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

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

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	
Course work	none	
Lecturer	Prof. Georg Fieg	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Title		Тур	Hrs/wk	СР
Particle Technology I (L043		Lecture	2	3
Particle Technology I (L043)		Recitation Section (small)	1	1
Particle Technology I (L044		Practical Course	2	2
Module Responsible	l			
Admission Requirements	None			
Recommended Previous Knowledge	keine			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence	After successful completion of the module stude			
Knowledge	<ul> <li>name and explain processes and unit-operations of solids process engineering,</li> <li>characterize particles, particle distributions and to discuss their bulk properties</li> </ul>			
Skills	<ul> <li>Students are able to</li> <li>choose and design apparatuses and pr solids properties of the product</li> <li>asses solids with respect to their behavi</li> <li>document their work scientifically.</li> </ul>			g to the desir
Personal Competence				
Social Competence	The students are able to discuss scientific topic develop solutions for technical-scientific issues	-	or scientific p	personal and
Autonomy	Students are able to analyze and solve question	ns regarding solid particles i	ndependent	ly.
	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
-				
Examination				
-	90 minutes	n): Coopialization Drasses F	nginooriaa	Compulser



Engineering: Compulsory Process Engineering: Core qualification: Compulsory

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

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



Course L0440: Particle 1	Fechnology I
	Practical Course
Hrs/wk	
CP	
	 Independent Study Time 32, Study Time in Lecture 28
	Prof. Stefan Heinrich
Language	
Cycle	
Content	<ul> <li>Sieving</li> <li>Bulk properties</li> <li>Size reduction</li> <li>Mixing</li> <li>Gas cyclone</li> <li>Blaine-test, filtration</li> <li>Sedimentation</li> </ul>
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.

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Module M0829: Fo	undations of Management			
Courses				
Title Introduction to Management Project Entrepreneurship (LC		<b>Typ</b> Lecture Project-/problem-based	Hrs/wk 3 2	<b>CP</b> 3 3
		Learning		
Module Responsible				
Admission Requirements				
Previous Knowledge	Basic Knowledge of Mathematics and Busin			
	After taking part successfully, students have	reached the following learning	g results	
Professional Competence	After taking this module, students know the	important basics of many diff	erent areas i	n Business and
Knowledge	<ul> <li>Management, from Planning and Organisation to Marketing and Innovation, and also to Investmen and Controlling. In particular they are able to</li> <li>explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management</li> <li>explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects</li> <li>describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management and marketing</li> <li>explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance</li> <li>state basics from accounting and costing and selected controlling methods.</li> </ul>			
Skills	<ul> <li>Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to <ul> <li>analyse Management goals and structure them appropriately</li> <li>analyse organisational and staff structures of companies</li> <li>apply methods for decision making under multiple objectives, under uncertainty and under ris</li> <li>analyse production and procurement systems and Business information systems</li> <li>analyse and apply basic methods of marketing</li> <li>select and apply basic methods from mathematical finance to predefined problems</li> <li>apply basic methods from accounting, costing and controlling to predefined problems</li> </ul> </li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Students are able to</li> <li>work successfully in a team of students</li> <li>to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project</li> <li>to communicate appropriately and</li> <li>to cooperate respectfully with their fellow students.</li> </ul>		vrite a coheren	
Autonomy	<ul> <li>Students are able to</li> <li>work in a team and to organize the te</li> <li>to write a report on their project.</li> </ul>	eam themselves		
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Fxamination	Subject theoretical and practical work			



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

Compulsory	1
General Engineering Science (English program, 7 semester): Specialisation Computer S	Science:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engin	neering:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Civil Engin	neering:
Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Energy and Envir Engineering: Compulsory	omental
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neerina.
Focus Mechatronics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering.
Focus Biomechanics: Compulsory	0,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering,
Focus Aircraft Systems Engineering: Compulsory	_
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	neering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin Focus Product Development and Production: Compulsory	neering,
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engi	neerina
Focus Energy Systems: Compulsory	looning,
Computational Science and Engineering: Core qualification: Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Logistics and Mobility: Core qualification: Compulsory	
Mechanical Engineering: Core qualification: Compulsory	
Mechatronics: Core qualification: Compulsory	
Naval Architecture: Core qualification: Compulsory	
Technomathematics: Core qualification: Compulsory	
Process Engineering: Core qualification: Compulsory	



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



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



Module M0891: Inf	ormatics for Process Engi	ineers			
Courses					
Title		٦	Гур	Hrs/wk	СР
Informatics for Process Eng	· · · ·			2	2
Informatics for Process Eng Numeric and Matlab (L0125	neers (L0837)		Recitation Section (small) Practical Course	2 2	2 2
Module Responsible	Dr. Marcus Venzke			-	-
Admission	None				
Requirements Recommended	Basic knowledge in using MS Wind	dows.			
Previous Knowledge					
Educational Objectives	After taking part successfully, stude	ents have reached	d the following learning	results	
Professional Competence					
	Students can describe procedural a	and object-orient	ed concepts.		
Knowledge					
	Students are capable of object-orie	ented programmi	ng in the programing lar	nguage Jav	a and of solvin
	mathematic questions by using Mat	tlab.			
	Students are capable of developing	g concepts (simp	e algorithms) to solve te	echnical que	estions.
Skills					
Personal Competence					
·	Students are able to work out solution	ions together in s	mall groups.		
Social Competence		-	-		
Autonomy	Students are able to assess acquire	ed skills by apply	ing it in practice.		
Workload in Hours	Independent Study Time 96, Study	Time in Lecture	34		
Credit points		-			
Examination					
Examination duration and scale	90 min				
	General Engineering Science (G	German program	): Specialisation Proc	ess Engine	ering: Electiv
	Compulsory	(0	<b>_ _</b>		_
	General Engineering Science ( Enviromental Engineering: Elective		am, 7 semester): Sp	pecialisatior	i Energy ar
	General Engineering Science (Ge		7 semester): Specialisa	ation Proces	ss Engineerin
	Elective Compulsory				0
Assignment for the	Bioprocess Engineering: Core qual				
Following Curricula	Energy and Environmental Enginee General Engineering Science (E			ess Enaine	ering: Electiv
	Compulsory		, I	•	-
	General Engineering Science (Eng	llish program, 7 s	emester): Specialisatio	n Energy ar	nd Enviroment
	Engineering: Elective Compulsory General Engineering Science (En	nglish program	7 semester): Specialisa	ation Proces	s Enaineerin
	Elective Compulsory				
	Process Engineering: Core qualification	ation: Compulso	ry		



Course L0836: Informati	ics 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	<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/



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

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

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	Hrs/wk	СР
e	2	2
tion Section (small)	1	1
y		
following loorning	a roquito	
following learning	gresuits	
in-depth knowled occur from produ methodological assess environm ironmental proces	uction proces diversity and nental impac sses as well	sses, projects d are compete tts. Besides th as uncertaintio
The students are able to select a suitable method for the respective case from the variety or assessment methods. Thereby they can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.		
The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivit and consciousness towards these subjects are raised and which helps to raise their awareness of their future social responsibilities in their role as engineers.		
The students learn to research, process and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business contex and are able to judge results of other publications.		
Specialisation E becialisation Proc 7 semester): S mester): Specialis ester): Specialisation pulsory	cess Engine Specialisation sation Proce	eering: Electi n Energy ai ss Engineerin
npuls on: C	sory compulsory	sory ompulsory

## TUHH Hamburg University of Technolog

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

Course L0860: Environmental Assessment		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl, Dr. Christoph Hagen Balzer	
Language	DE/EN	
Cycle	SoSe	
	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: Environn	nental Assessment
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
Content	Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject- specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.
Literature	Power point Präsentationen

## Thesis

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Courses				
Title		Тур	Hrs/wk	СР
Module Responsible	Professoren der TUHH			
Admission Requirements	<ul> <li>According to General Regulations § At least 126 ECTS credit points has board decides on exceptions.</li> </ul>		tudy programme. Th	e examinatior
Recommended Previous Knowledge				
	After taking part successfully, students have	reached the following	learning results	
Professional Competence				
Knowledge	<ul> <li>The students can select, outline and fundamentals of their course of stude</li> <li>On the basis of their fundamental relation to a specific issue of oper expertise.</li> <li>The students are able to outline the</li> </ul>	y (facts, theories, and n knowledge of their s ning up and establishi	nethods). ubject the students ing links with extend	are capable ded specialize
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 analy problems, make decisions on technical issues, and develop solutions.</li> <li>The students can take up a critical position on the findings of their own research work from specialized perspective.</li> </ul>		nts can analyz	
Personal Competence				
Social Competence	<ul> <li>Both in writing and orally the stude accurately, understandably and in a</li> <li>The students can deal with issues in appropriate to the addressees. In viewpoints convincingly.</li> </ul>	structured way. an expert discussion	and answer them in a	a manner that
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 tworking 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 ir	Lecture 0		
Credit points	12			
Examination	Thesis			
Examination duration and scale	According to General Regulations			

Assignment for the Following Curricula Mechanical E Mechatronics: Naval Archited X: Thesis: Co	vironmental Engineering: Thesis: Compulsory ingineering: Thesis: Compulsory gineering: Thesis: Compulsory Environmental Engineering: Thesis: Compulsory ineering Science (English program): Thesis: Compulsory ineering Science (English program, 7 semester): Thesis: Compulsory al Science and Engineering: Thesis: Compulsory al Science and Engineering: Thesis: Compulsory al Science and Engineering: Thesis: Compulsory I Mobility: Thesis: Compulsory Engineering: Thesis: Compulsory s: Thesis: Compulsory s: Thesis: Compulsory entics: Thesis: Compulsory ematics: Thesis: Compulsory ompulsory ineering: Thesis: Compulsory
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