Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2018 Updated: 30th April 2020

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Program description

Content

The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study (civil engineering, biotechnology, electrical engineering, energy- and environmental engineering, computer science, mechanical engineering, medical engineering, naval engineering, process engineering), some of them with further specialisations. GES has with 210 credit points a higher workload compared to other Bachelor study courses. Therefore General Engineering Science is designed for 7 semesters.

Career prospects

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

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

The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master studies, of another technical or of an economic oriented Master study. Most of the modules in the 1st and the 2nd 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.

Core qualification

Module M0701: C	hemistry (GES)			
Courses				
Title Chemistry (GES) I (L0467) Chemistry (GES) I (L0478) Chemistry (GES) II (L0469) Chemistry (GES) II (L0479)	Lectur	tion Section (large)	Hrs/wk 2 1 2 1	CP 2 1 2 1
Module Responsible	Dr. Christoph Wutz			
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 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				
•	Students are able to take part in discussions on chemi interdisciplinary team. They can contribute to those discu	ical issues and pro ssion by their own	blems as a statements.	member of a
Autonomy	After successful completion of this module students are a by defending proposed approaches with arguments. They			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (English program): Core qua General Engineering Science (English program, 7 semeste			sory

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

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

Course L0469: Chemistry (GES) II		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Holger Gulyas	
Language	EN	
Cycle	WiSe	
Content	 Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons, Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction Practical applications and examples 	
Literature	 Gallagher, Ingram: Complete Chemistry (Oxford University Press) Corwin: Introductory Chemistry (Pearson) Burrows, Parsons, Price, Holman: Chemistry3 (Oxford University Press) 	

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

Courses					
Title		Тур	Hrs/wk	СР	
Programming in C (L0083)		Lecture	1	1	
Programming in C (L1488)		Practical Course	1	1	
Module Responsible	÷				
Admission Requirements	None				
•	Elementary PC handling skills				
Recommended Previous Knowledge	Elementary mathematical skills				
Educational Objectives	After taking part successfully, stud	ents have reached the following lea	rning results		
Professional			<u> </u>		
Competence			:		
	purpose.	sic syntax of C programming as wel	i as its meaning,	Intent and	
	They know the fundamental components and principles of elementary procedural programming based on C programming and can explain them:				
Knowledge		rrays, strings, composed data types s, logical operations, bit operations) s, conditional compilation))	
	The students are prepared for continuing programming lectures like object oriented programming $C++$.				
	The students know how to use an i so that they can write, store, comp	ntegrated development environmen ile and execute C programs on it.	t for C programm	ing on a PC	
	Using their knowledge they are able to read and understand given C Programs.				
Skills	They can solve simple algorithmic problems on their own and can model and program their solutions in C language.				
	The students are able to solve selected exercises from other areas of their study like mathematics, mechanics, electrical engineering or physics with the aid of small C programs/-projects numerically.				
Personal Competence					
	The students are able to work in sr programming errors and to presen	nall teams to solve given weekly tas t their results.	ks, to identify an	d analyze	
Social Competence					
	They are able to explain simple phenomena to each other directly at the PC.				
	The students prepare themselves using the given teaching material and solve the given programming exercises on their own.				
Autonomy	Additionally, they write small C programs to understand and check addressed issues and also to gain a certain programming experience.				
	For details beyond the scope of the literature and / or by supplementa	e lecture the students inform themse ry own research.	elves using the st	ated	
Workload in Hours	Independent Study Time 32, Study	Time in Lecture 28			
Credit points					
Course achievement					
	Written elaboration				
	1-2 coding tasks weekly				
Assignment for the	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				

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

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	

Courses				
Title	1	Гур	Hrs/wk	СР
Linear Algebra (L0642)		ecture	4	4
Linear Algebra (L0643) Linear Algebra (L0645)		Recitation Section (large) Recitation Section (small)	2 2	2 2
_		vectation section (smail)	Z	Z
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning	results	
Professional Competence				
Knowledge	 Students can name the basic concepts in lin appropriate examples. Students can discuss logical connections I illustrating these connections with the help of They know proof strategies and can reproduce 	between these concep		
Skills	 Students can model problems in linear alge course. Moreover, they are capable of solving Students are able to discover and verify for studied in the course. For a given problem, the students can develop critically evaluate the results. 	them by applying estab urther logical connection	lished meth	ods. n the concep
Personal Competence				
	- Students are able to work together (e.g. on their			
Social Competence	teams (i.e., teams from different study programs a results appropriately (e.g. during exercise class).	and background knowle	dge) and t	o present the
	 Students are capable of checking their understan specify open questions precisely and know where to 			own. They ca
Autonomy	- Students can put their knowledge in relation to the	contents of other lectur	es.	
	 Students have developed sufficient persistence to b manner on hard problems. 	be able to work for longe	er periods in	a goal-oriente
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	120			
Accianment for the	Computer Science: Core qualification: Compulsory			
Assignment for the	General Engineering Science (English program): Core			

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

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

ırse L0645: Linear Algebra	
Recitation Section (small)	
2	
2	
Independent Study Time 32, Study Time in Lecture 28	
Dr. Francisco Javier Hoecker-Escuti	
EN	
WiSe	
See interlocking course	
See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Mechanics I (GES) (L1373)		Lecture	2	3
Mechanics I (GES) (L1374)		Recitation Section (large)	3	3
	Prof. Radoslaw Iwankiewicz			
Admission Requirements	None			
Requirements				
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
Knowledge	 Demonstrate sound techniques of real engineering systems; Promote the analytical and probl engineering problems effectively. 	principles required to analyse the d simple structures in equilibrium; constructing and solving idealise em-solving skills required to sol	effects of fo	orces applied
Skills	 At the end of this course the student is at Apply the properties of two- and t elements and simple structures in e Isolate a body in equilibrium by dra body are represented. Analyse the external effects of forc three-dimensional equilibrium using Analyse the internal forces in truss Solve problems of equilibrium with Determine mass centres and centre 	hree-dimensional force systems t equilibrium. awing its free-body diagram on wh es acting on a single body or a sy g the free-body diagram of the boo es and beams. account for dry friction.	nich all force	es acting on tl dies in two- a
Personal Competence				
Social Competence	Students can: - work in groups and report present them to others, - assess the team	collaboration and their own share	in it.	
Autonomy	Students are able to: - solve the probler strengths and weaknesses, e.g. with the a		of hints, - a	ssess their ov
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration	1.5 hours Statics: force systems, equilibriu	fristing to the		

Course L1373: Mechani	ics 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	 Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity. Equilibrium in two and three dimensions. Equations of equilibrium. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses. Simple structures: frames and machines. Mass centers and centroids of lines, areas and volumes. Friction: dry friction, types of friction problems. Beams: internal effects- internal forces. Internal forces in curved-in-plane members. * Virtual work principle. * Denotes an additional topic.
Literature	 J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4^t Edition. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3rd Edition.

Course L1374: Mechani	ics 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	 Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity. Equilibrium in two and three dimensions. Equations of equilibrium. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses. Simple structures: frames and machines. Mass centers and centroids of lines, areas and volumes. Friction: dry friction, types of friction problems. Beams: internal effects- internal forces. Internal forces in curved-in-plane members. * Flexible cables. * Virtual work principle. * Denotes an additional topic.
Literature	 J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4^{tl} Edition. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3rd Edition.

Courses				
Title Physics for Engineers (GES)	(L0557)	Typ Lecture	Hrs/wk 2	CP 3
Physics for Engineers (GES)	(L0560)	Recitation Section (small)	1	1
Module Responsible	Dr. Alexander Petrov			
Admission Requirements	NODA			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, st	tudents have reached the following learning	results	
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics such as in the areas of mechanic oscillations, waves, and optics.			
	Students can relate physics topi	ics 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 within the framework of the pro	ct related problems in groups. They can pres blem solving courses.	sent their re	sults effective
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, Stu	udy Time in Lecture 42		
Credit points	4			
Course achievement	None			
	Written exam			
Examination duration and scale	120 Minutes, 10 tasks with parts	s a) and b)		
		nglish program): Core qualification: Compuls nglish program, 7 semester): Core qualificati		

τνρ	Lecture
Hrs/wk	
CP	
	Independent Study Time 62, Study Time in Lecture 28
	Dr. Alexander Petrov
Language	EN
Cycle	
Content	 Introduction Kinematics and dynamics Work, Energy, momentum Rotatory Motion, moments of inertia Gravitation Special Theory of Relativity Oscillations Waves Geometrical optics Water waves Fundamentals of quantum mechanics
Literature	 D. Halliday, R. Resnick and J. Walker ("HRW-7"), Fundamentals of Physics - Extended Edition, 7 ed., (Wiley 2005); available in the TUHH Library 'Lehrbuchsammlung'. K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, (Wiley 2004) available in the TUHH Library 'Lehrbuchsammlung'. Other books that cover similar topics are, e.g., Physics by Fishbane, Gasiorowicz and Thornto and Physics by Tipler and Mosca.

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

Module Responsible	Dagmar Richter
Admission Requirements	
Recommended Previous Knowledge	None
	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 to 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 means 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 to 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 degree courses
	The learning architecture demands and trains independent educational planning as regards t 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 to 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 acro semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning courses are part of the learning architecture and are deliberately encouraged in specific courses.
	Fields of Teaching
Knowledge	are based on research findings from the academic disciplines cultural studies, social studies, ar historical studies, migration studies, communication studies and sustainability research, and fro engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's cours will have the opportunity to learn about business management and start-ups in a goal-oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the foc 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 top 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 positio and different group leadership functions of Bachelor's and Master's graduates in their future worki life.
	Specialized Competence (Knowledge)
	Students can
	 locate selected specialized areas with the relevant non-technical mother discipline, outline basic theories, categories, terminology, models, concepts or artistic techniques in t disciplines represented in the learning area, different specialist disciplines relate to their own discipline and differentiate it as well as ma connections,
	 sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methor and forms of representation in the specialized sciences are subject to individual and soc cultural interpretation and historicity, Can communicate in a foreign language in a manner appropriate to the subject.
	Professional Competence (Skills)
	• • •

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

Skills	 apply basic methods of the said scientific disciplines, auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline, to handle simple questions in aforementioned scientific disciplines in a sucsessful manner, justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.
Personal Competence	
	Personal Competences (Social Skills)
	Students will be able
Social Competence	 to learn to collaborate in different manner, to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees, 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), to explain nontechnical items to auditorium with technical background knowledge.
	Personal Competences (Self-reliance)
	Students are able in selected areas
Autonomy	 to reflect on their own profession and professionalism in the context of real-life fields of application to organize themselves and their own learning processes to reflect and decide questions in front of a broad education background to communicate a nontechnical item in a competent way in writen form or verbaly to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)
Workload in Hours	Depends on choice of courses

Courses

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

Courses					
Title			Тур	Hrs/wk	СР
Electrical Engineering I (L06	77)		Lecture	3	5
Electrical Engineering I (L06	79)		Recitation Section (sma	ll) 2	1
Module Responsible	Prof. Manfred Kasper				
Admission Requirements	None				
Recommended Previous Knowledge	None				
Educational Objectives	After taking part succe	essfully, students h	ave reached the following learni	ng results	
Professional Competence			<u>_</u>	-	
Knowledge Skills	 Basic material relations, Gauss's law, Ampère's law, induction law, Maxwell's equation in the integral form, concept and definition of resistance, capacitance and inductance. The students are able to establish relations between currents and voltages in simple direct current networks and to apply these to calculate and dimension networks. Student know to apply the fundamental laws of electric and magnetic fields and are able to derive and evaluate relations between field quantities. Students know to calculate resistance, capacitance and inductance of simple geometric				
Personal Competence		olve specific proble	ems alone or in a group and to p	resent the resu	ults according
Social Competence	Students can explain o	concepts and on the	e basis of examples verify and d	eepen their un	derstanding.
Autonomy	Students are able to acquire particular knowledge using textbook in a self-learning process, to integrate, present and associate this knowledge with other fields. The students develop perseverance to also solve more complicated problems.				
Workload in Hours	Independent Study Tin	ne 110, Study Time	e in Lecture 70		
Credit points	6				
Course achievement	CompulsorBonus No 10 %	Form Excercises	Description		
Examination	Written exam				
Examination duration and scale					

Course L0677: Electrica	al Engineering I	
Тур	Lecture	
Hrs/wk		
СР	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Prof. Manfred Kasper	
Language	EN	
Cycle	WiSe	
Content	 Basics of Resistive Circuits Simplifying Resistive Circuits Network Analysis The Electrostatic Field Stationary Currents in Conductive Media Electrostatic Field in Non-Conductive Media Electrostatic Field Induction and Time-Dependent Fields 	
Literature	 M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013 A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008 P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996 M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004 F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005 	

Course L0679: Electrical Engineering I		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Manfred Kasper	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0671: T	echnical Thermodynamics I			
Courses				
		— ——	Lluce (see le	<u></u>
Title Technical Thermodynamics	1 (10437)	Typ Lecture	Hrs/wk 2	СР 4
Technical Thermodynamics		Recitation Section (large)	1	1
Technical Thermodynamics		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Elementary knowledge in Mathematics and Me	echanics		
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Kaauladaa	Students are familiar with the laws of Thermodynamics. They know the relation of the kinds of energy according to 1 st law of Thermodynamics and are aware about the limits of energy conversions according to 2 nd law of Thermodynamics. They are able to distinguish between state variables and process variables and know the meaning of different state variables like temperature, enthalpy, entropy and also the meaning of exergy and anergy. They are able to draw the Carnot cycle in a Thermodynamics related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equations of state. They know the meaning of a fundamental state of equation and know the basics of two phase Thermodynamics.			
	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 grou	ps and develop an approach.		
	Students are able to define independently tasks, to get new knowledge from existing knowledge as wel as to find ways to use the knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	90 min			
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 Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory			

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

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

Courses		-	11	
Fitle Electrical Engineering II (L07	(47)	Typ Lecture	Hrs/wk 3	CP 5
Electrical Engineering II (L07			2	1
Module Responsible	Dr. Helge Fielitz			
Admission Requirements	None			
Recommended Previous Knowledge	Content of the Lecture "Electrical Enginee	ering I (Elektrotechnik I)"		
ducational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence	The students know the basic theory, re			
Knowledge	 transients, the use of complex numbers and phasors, the concept of impedance, steady state sinusoidal circuit analysis, complex power and 3-phase systems, transformers, transfer function and filters, the concept of resonance, diodes and rectifiers, bipolar transistors and operational amplifiers 			
Skills	The students are able to establish relati networks. The students know how to app filter-like structures, and resonating net elements, such as diodes, bipolar transist	oly network theory to analyze 3-ph works. The students know to incl	ase system ude basic r	s, transformer nonlinear circu
Personal Competence				
	Students are able to solve specific problems, alone or in a group, and to present the result			
	Students are able to acquire particular knowledge using textbooks in a self-learning process, to integrate, present, and associate this knowledge with other fields. The students develop persistency to also solve more complicated problems.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes			

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

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

Courses				
Title		yp	Hrs/wk	СР
Mechanics II (GES) (L1417) Mechanics II (GES) (L1418)		ecture ecitation Section (large)	2 2	3 3
		section (large)	2	5
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements				
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have reached	the following learning	results	
Professional Competence				
Knowledge	The primary purpose of the study of Mechanics predict the effects of forces on elastic bodies, structurest (in equilibrium). Such a capacity is critical to the The particular objectives of this course are to: 1. Introduce the student to the basic principles re	ural elements and simp design of many structu	ole structure ral or engine	es, which are eering system
Knowiedge	 elastic bodies, structural elements and simple structures in equilibrium; 2. Demonstrate sound techniques of constructing and solving idealised mathematical models real engineering systems; 3. Promote the analytical and problem-solving skills required to solve a wide variety of reengineering problems effectively. 			
	At the end of this course the student should be able			
Skills	 Determine average normal and shear stresses. Determine shear stresses and the angle of twist due to torsion of a circular shaft. Determine thermal stresses in rods. Analyse statically indeterminate rods and shafts Determine area moments of inertia as well as principal axes and moments of inertia. Determine normal and shear stresses as well as deflections due to bending. Analyse plane state of stress (stress transformation). Analyse stability of equilibrium of simple systems and buckling of elastic columns. Determine displacements and solve statically indeterminate problems with the aid of energy (Castigliano's) method. 			
Personal Competence				
Social Competence	Students can: -work in groups and report on the find present them to others, - assess the team collaboration			ixed teams ar
Autonomy	$\frac{1}{2}$			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56		
Credit points	6			
Course achievement				
Examination				
Examination duration	1.5 hours Mechanics of Solids: stress and strain	due to axial loading	. torsion. I	oendina, stre

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

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

C				
		-	11	
Title Mathematical Analysis (L064	47)	Typ Lecture	Hrs/wk 4	СР 4
Mathematical Analysis (L064		Recitation Section (large)	2	2
Mathematical Analysis (L064	49)	Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	 Students can name the basic condappropriate examples. Students can discuss logical connections with the illustrating these connections with the They know proof strategies and can response to the stra	ections between these concep e help of examples.	-	
Skills	 Students can model problems in analysis with the help of the concepts studied in this course. Students are able to discover and verify further logical connections between the concept studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able t critically evaluate the results. 			
Personal Competence				
Social Competence	- Students are able to work together (e.g. teams (i.e., teams from different study pro results appropriately (e.g. during exercise cl	ograms and background knowle		
	- Students are capable of checking their u specify open questions precisely and know v	where to get help in solving then	ı.	own. They ca
Autonomy	- Students can put their knowledge in relation	on to the contents of other lectur	es.	
	- Students have developed sufficient persist manner on hard problems.	ence to be able to work for longe	er periods in	a goal-oriente
Workload in Hours	Independent Study Time 128, Study Time in	Lecture 112		
Credit points	8			
Course achievement				
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Computer Science: Core qualification: Comp General Engineering Science (English progra General Engineering Science (English progra	am): Core qualification: Compuls		

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

rse L0648: Mathematical Analysis		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Francisco Javier Hoecker-Escuti, Jan Meichsner	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

ourse L0649: Mathematical Analysis		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Francisco Javier Hoecker-Escuti	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title	l En air	$C_{\rm C}$	Typ Lecture	Hrs/wk 2	CP
Fundamentals of Mechanica Fundamentals of Mechanica			Recitation Section (smal	_	3 3
Module Responsible				, –	
Admission					
Requirements	None				
Recommended Previous Knowledge		Basic knowledge about mechanics a Internship (Stage I Practical)	nd production engineering		
Educational Objectives	After	taking part successfully, students ha	ve reached the following learnin	g results	
Professional Competence					
	After	passing the module, students are abl	e to:		
Knowledge		explain basic working principles and explain requirements, selection cri machine elements, indicate the bac	teria, application scenarios and	d practical ex	amples of bas
	After	passing the module, students are ab	e to:		
Skills	•	accomplish dimensioning calculation transfer knowledge learned in the skills), recognize the content of technical d technically evaluate basic designs.	module to new requirements	and tasks (oroblem solvir
Personal Competence					
Social Competence	Stude	ents are able to discuss technical info	rmation in the lecture supported	d by activating) methods.
Autonomy		Students are able to independently Students are able to acquire additio e.g. by using the video recordings o	nal knowledge and to recapitula		
Workload in Hours	Indep	endent Study Time 124, Study Time	in Lecture 56		
Credit points	6				
Course achievement	None				
Examination	Writt	en exam			
Examination duration and scale	120 r	nin			
Assignment for the Following Curricula	Gene	ral Engineering Science (English prog	ram, 7 semester): Core qualifica	ation: Compul	sory

Hrs/wk 2 CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Dr. Arthur Seibel Language EN Cycle 50Se Lecture • Introduction to design • Introduction to the following machine elements • Screws • Shaft-hub joints • Rolling contact bearings • Welding / adhesive / solder joints • Springs • Axes & shafts • Presentation of technical objects (technical drawing) Exercise • Calculation methods for dimensioning the following machine elements: • Screws • Shaft-hub joints • Springs • Axes & shafts • Presentation of technical objects (technical drawing) Exercise • Calculation methods for dimensioning the following machine elements: • Screws • Shaft-hub joints • Soling contact bearings • Welding / adhesive / solder joints	iyp	Lecture
CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Dr. Arthur Seibel Language EN Cycle SoSe Lecturer • Introduction to design • Introduction to the following machine elements • Screws • Shaft-hub joints • Shaft-hub joints • Welding / adhesive / solder joints • Springs • Axes & shafts • Presentation of technical objects (technical drawing) Exercise • Calculation methods for dimensioning the following machine elements: • Screws • Shaft-hub joints • Rolling contact bearings • Mediang / adhesive / solder joints • Springs • Axes & shafts • Presentation of technical objects (technical drawing) Exercise • Calculation methods for dimensioning the following machine elements: • Screws • Shaft-hub joints • Shaft-hub joints • Rolling contact bearings • Welding / adhesive / solder joints • Welding / adhesive / solder joints		
Lecturer Dr. Arthur Seibel Language EN Cycle SoSe Lecture Introduction to design Introduction to the following machine elements Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts Presentation of technical objects (technical drawing) Exercise Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Velding / adhesive / solder joints Springs Axes & shafts 		
Lecturer Dr. Arthur Seibel Language EN Cycle SoSe Lecture Introduction to design Introduction to the following machine elements Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts Presentation of technical objects (technical drawing) Exercise Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Velding / adhesive / solder joints Springs Axes & shafts 	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Cycle SoSe Lecture Introduction to design Introduction to the following machine elements Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts Presentation of technical objects (technical drawing) Exercise Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints 		
Lecture • Introduction to design • Introduction to the following machine elements • Screws • Shaft-hub joints • Rolling contact bearings • Welding / adhesive / solder joints • Springs • Axes & shafts • Presentation of technical objects (technical drawing) Exercise • Calculation methods for dimensioning the following machine elements: • Screws • Shaft-hub joints • Rolling contact bearings • Rolling contact bearings • Welding / adhesive / solder joints	Language	EN
 Introduction to design Introduction to the following machine elements 	Cycle	SoSe
 Springs Axis & shafts 	Content	 Introduction to the following machine elements Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Axes & shafts Presentation of technical objects (technical drawing) Exercise Calculation methods for dimensioning the following machine elements: Screws Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Shaft-hub joints Rolling contact bearings Welding / adhesive / solder joints Springs Welding / adhesive / solder joints Springs Springs Solder joints Springs Springs Springs

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

Courses				
Title Technical Thermodynamics	11 (1 0 4 4 9)	Typ Lecture	Hrs/wk 2	CP 4
Technical Thermodynamics		Recitation Section (large)	1	1
Technical Thermodynamics		Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
	Elementary knowledge in Mathematics, Mec	hanics and Technical Thermodyr	namics I	
	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence				
Knowledge	Clausius-Rankine. They are able to derive a different factors. They know the difference cycle, cooling cycle). They have increased k cycles in Thermodynamics related diagram air processes and are able to perform sim knowledge in gas dynamics and know the nozzle.	between anti clockwise and clo nowledge of steam cycles and al s. They know the laws of gas mi ple combustion calculations. Th	ockwise cyc re able to di ixtures, esp ey are prov	les (heat-powe raw the differe ecially of hum vided with bas
Skills	Students are able to use thermodynamic lat able to formulate energy, exergy- and entry They are able to perform simple safety cal are able to transform a verbal formulated m	opy balances and by this to op culations in regard to an outflow	timise tech ving gas fro	nical processe
Personal Competence				
Social Competence	The students are able to discuss in small gro	oups and develop an approach.		
	Students are able to define independently ta	asks to get new knowledge from	evisting kr	owledge as we
	as to find ways to use the knowledge in prac		i chisting ki	iomicage as m
Autonomy				
hatohomy				
Workload in Hours	Independent Study Time 124 Study Time in	Locturo E6		
Credit points	Independent Study Time 124, Study Time in			
Course achievement				
	Written exam			
Examination duration				
and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German progr Bioprocess Engineering: Core qualification: Energy and Environmental Engineering: Cor General Engineering Science (English progra Computational Science and Engineering: Sp Mechanical Engineering: Core qualification: Mechatronics: Core qualification: Compulsor Technomathematics: Specialisation III. Engin Process Engineering: Core qualification: Cor	Compulsory e qualification: Compulsory am, 7 semester): Core qualificati ecialisation Engineering Science Compulsory y neering Science: Elective Compu	on: Compul s: Elective C	sory

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

Course L0450: Technica	ourse L0450: Technical Thermodynamics II		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	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: Technica	ourse 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		

Courses				
Title		Тур	Hrs/wk	СР
Mechanics III (GES) (L1421)		Lecture	3	3
Mechanics III (GES) (L1420) Mechanics III (GES) (L1419)		Recitation Section (small) Recitation Section (large)	2 1	2 1
	Prof. Radoslaw Iwankiewicz		-	-
Admission				
Requirements				
Recommended Previous Knowledge	None			
ducational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
	The primary purpose of the study of Mechanics the capacity to predict the effects of forces a moving machine parts, different machinery, ve etc.The particular objectives of this course are t	and motions, necessary for ehicles, aircraft, spacecraft,	the analysis	and design
 Determine the hydrostatic forces acting on different objects. Analyse stability of floating bodies. Analyse the kinematics and kinetics of a particle in different reference systems, Analyse the motion of the system of particles and forces acting on it, Analyse the plane motion of a rigid body (simple mechanism) and forces acting on it. Analyse the three-dimensional motion of a rigid body and forces acting on it. 				
Skills	At the end of this course the student should be able to:			
	 Solve the equilibrium problems with account for hydrostatic pressure forces. Analyse stability of simple floating bodies. 			
	3. Calculate the velocity and acceleration of a particle in different reference systems.			
	• 4. Derive and solve the equation of motion of a particle in different reference systems.			
	5. Analyse the motion of the system of particles and forces acting on it with the aid of work-energy ar impulse-momentum relationships,			
	6. Calculate the instantaneous linear and angular velocities and accelerations of the plant 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 thre 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 and kinetics of rigid body both methods of vector algeb and matrix methods.			
Personal Competence				
Social Competence	Students can: - work in groups and report on th present them to others, - assess the team colla	boration and their share in it.		
Autonomy	Students are able to: -solve the problems inc strengths and weaknesses, e.g. with the aid of		f hints, - as	ssess their ov
	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points				
Course achievement				
Examination				
Examination duration and scale				
	,			

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

Тур	Recitation Section (small)
Hrs/wk	2
CP	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

ourse L1419: Mechanics III (GES)			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Radoslaw Iwankiewicz		
Language	EN		
Cycle	WiSe		
Content	 Plane kinematics of a rigid body. Relative (compound) motion. Three-dimensional kinematics of a rigid body. KINETICS Kinetics of a particle and of a system of particles. Plane kinetics of a rigid body. Three-dimensional kinetics of a rigid body. 		
Literature	 J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 2, Dynamics, John Wiley & Sons, SI Version 4th Edition R.C. Hibbeler, Engineering Mechanics, Dynamics, Pearson, Prentice Hall, SI 3rd Edition 		

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Courses				
Title		Тур	Hrs/wk	CP
Analysis III (L1028) Analysis III (L1029)		Lecture Recitation Section (small)	2 1	2 1
Analysis III (L1030)		Recitation Section (large)	1	1
Differential Equations 1 (Or	dinary Differential Equations) (L1031)	Lecture	2	2
	dinary Differential Equations) (L1032)	Recitation Section (small)	1	1
	dinary Differential Equations) (L1033)	Recitation Section (large)	1	1
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	Mathematics I + II			
	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
competence				
Knowledge	 Students can name the basic concepts in the area of analysis and differential equations. They a able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. They know proof strategies and can reproduce them. 			
Skills	 Students can model problems in the area of analysis and differential equations with the help the concepts studied in this course. Moreover, they are capable of solving them by applyir established methods. Students are able to discover and verify further logical connections between the concep studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. 			
Personal Competence	Students are able to work together in	teams. They are capable to use	mathemati	cs as a comm
Social Competence	 language. In doing so, they can communicate r partners. Moreover, they can design peers. 			
Autonomy	 Students are capable of checking their understanding of complex concepts on their own. Th can specify open questions precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goo oriented manner on hard problems. 			
Workload in Hours	Independent Study Time 128, Study Time in	Lecture 112		
Credit points	8			
Course achievement	None			
	Written exam			
Examination duration and scale	60 min (Analysis III) + 60 min (Differential E	quations 1)		
Assignment for the Following Curricula				

Process Engineering: Core qualification: Compulsory

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	 Main features of differential and integrational calculus of several variables Differential calculus for several variables Mean value theorems and Taylor's theorem Maximum and minimum values Implicit functions Minimization under equality constraints Newton's method for multiple variables Double integrals over general regions Line and surface integrals Theorems of Gauß and Stokes
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1029: Analysis	ourse 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 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: Differen	tial Equations 1 (Ordinary Differential Equations)	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	 Main features of the theory and numerical treatment of ordinary differential equations Introduction and elementary methods Exsitence and uniqueness of initial value problems Linear differential equations Stability and qualitative behaviour of the solution Boundary value problems and basic concepts of calculus of variations Eigenvalue problems Numerical methods for the integration of initial and boundary value problems Classification of partial differential equations 	
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 	

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

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

Courses		
Title	Typ Hrs/wk CP	
Module Responsible		
Recommended Previous Knowledge	1 50 (reditionists 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 an learning typical tasks and functions of engineers. They are able to structure and organize their workin 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	
Autonomy	Students can finish own tasks.	
Workload in Hours	Independent Study Time 540, Study Time in Lecture 0	
Credit points	18	
Course achievement	None	
Examination	Written elaboration (accord. to Internship Regulations)	
Examination duration and scale	see Internship Regulations	
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core qualification: Compulsory Engineering Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory	

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Specialization Civil Engineering

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

Module M0580: P	rinciples of Building Materials and	d Building Physics		
Courses				
Title Building Physics (L0217) Building Physics (L0219)		Typ Lecture Recitation Section (large)	Hrs/wk 2 1	CP 2 1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materi	als (L0215)	Lecture	2	2
Module Responsible	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 reac	hed the following learning	results	
Professional Competence				
Knowledge	The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processes and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise.			
Skills	The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building.			
Personal Competence				
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge.			
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	2 h written exam			
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qualifi General Engineering Science (English progra Compulsory Orientierungsstudium: Core qualification: Elective Technomathematics: Specialisation III. Engineerin	cation: Compulsory m, 7 semester): Specia Compulsory	lisation Civ	5 5

Course L0217: Building	Physics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection, noise protection
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

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

Course L0247: Building	urse 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: Principle	es 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
	Structure of building materials Effects of action Fundamentals of mechanical behaviour Material testing Principles of metals Joining methods
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8

Courses					
Title			Тур	Hrs/wk	СР
Structural Analysis I (L0666))		Lecture	2	3
Structural Analysis I (L0667))		Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek				
Admission Requirements	None				
Recommended Previous Knowledge	Mechanics I, Mathema	atics I			
Educational Objectives	After taking part succ	cessfully, students have read	ched the following learning	results	
Professional Competence					
Knowledge	After successfully co analysis of statically o	mpleting this module, stud determinate systems.	dents can express the bas	sic aspects	of linear fran
Skills	determinate and inde	ppletion of this module, the eterminate structures. They cically determinate plane an	are able to analyze state	variables a	
Personal Competence					
Social Competence	 defend their ov promote the so	subject-specific and interdiso wn work results in front of o cientific development of coll hey can give and accept pro	thers eagues	cism	
Autonomy		le work in-term homework s their learning progress du			dback, they a
Workload in Hours	Independent Study Ti	ime 124, Study Time in Lect	ure 56		
Credit points	6				
	CompulsorBonus	Form	Description		
Course achievement	No 10 %	Written elaboration	Hausübungen mit Studentische Tutoren (⁻		etreut durc
	Written exam				
Examination duration and scale	90 Minuten				
	Compulsory Civil- and Environmer General Engineering Compulsory	g Science (German progr ntal Engineering: Core qualit g Science (English progra Specialisation III. Engineerin	fication: Compulsory am, 7 semester): Specia	lisation Civ	-

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

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

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Module M0590: B	anang nateria	s and Bunan	ig enemistry			
Courses						
Title			Тур	Hrs/wk	СР	
Building Materials and Build Building Materials and Build			Lecture Recitation Section (4 small) 1	4 2	
Module Responsible	Prof. Frank Schmidt-Dö	hl				
Admission Requirements	None					
Recommended Previous Knowledge	Module Principles of Ru	ilding Materials an	d Building Physics			
Educational Objectives	After taking part succes	ssfully, students ha	ve reached the following lea	arning results		
Professional Competence						
Knowledge	most important charac	The students are able to explain the most important components, the manufacture, the structure, the most important characteristics of the mechanical behaviour and the corrosion behaviour, the material testing and the fields of utilization of all relevant building materials.				
Skills	The students are able to assess the usability of building materials for different applications and to select building materials according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concrete and to consider the mixture in respect to the actua rules and the connections between the characteristic concrete parameters. They are able to select suitable materials and mixtures to avoid damage processes.					
Personal Competence	The students are able learning groups and to		other to learn the very e in small groups in the lab.	xtensive specialis	t knowledge	
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.					
Workload in Hours	Independent Study Tim	e 110, Study Time	in Lecture 70			
Credit points	6					
Course achievement	CompulsorBonusFormDescriptionNo10 %Presentation					
Examination	Written exam					
Examination duration and scale	Z n whiten exam					
	Compulsory Civil- and Environmenta	al Engineering: Cor Science (English	program, 7 semester): e qualification: Compulsory program, 7 semester):			

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

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

Module M0706: G	eotechnics I				
Courses					
Title Soil Mechanics (L0550) Soil Mechanics (L0551) Soil Mechanics (L1493)			Typ Lecture Recitation Section (larg Recitation Section (sma		CP 2 2 2
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	Modules : • Mechanics I-II				
Educational Objectives	After taking part succe	ssfully, students	have reached the following learni	ng results	
	The students know th	ight, water or st	mechanics as the structure and ructures, consolidation and settl e failure.		,
	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 calculat 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 Tin	ne 96, Study Time	e in Lecture 84		
Credit points	6				
Course achievement	Compulsor BonusNo20 %	Form Attestation	Description		
	Written exam				
Examination duration and scale	60 minutes				
	Compulsory Civil- and Environment General Engineering Compulsory	al Engineering: C Science (Englis	n program, 7 semester): Spe ore qualification: Compulsory h program, 7 semester): Spe Engineering Science: Elective Con	ecialisation Civ	_

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

Course L0551: Soil Mec	Irse 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			

Tum	Recitation Section (small)
Тур	
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

Courses					
Title			Тур	Hrs/wk	СР
Project Seminar Concrete I ((L0896)		Seminar	1	1
Reinforced Concrete Design	I (L0303)		Lecture	2	3
Reinforced Concrete Design	I (L0305)		Recitation Section (arge) 2	2
Module Responsible	Prof. Günter Rombach				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge in stru	uctural analysis and	building materials.		
Educational Objectives	After taking part succe	ssfully, students ha	ve reached the following lea	arning results	
Professional Competence					
Knowledge	The students can outline the history of concrete construction and explain the basics of structura 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 o structural members.				
Skills	The students are able to apply basic procedures of the conception and dimensioning to practic cases. They are capable to draft simple concrete structures and to design them for bending an bending with axial force, and to plan their detailing and execution. Moreover, they can make desig 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 critically reflect the results.				
Workload in Hours	Independent Study Tim	ne 110, Study Time	in Lecture 70		
Credit points	6				
Course achievement	Compulsor B onus Yes None	Form Excercises	Description		
Examination	Written exam				
Examination duration and scale	120 minutes				
Assignment for the Following Curricula	Compulsory Civil- and Environment	al Engineering: Cor	program, 7 semester): e qualification: Compulsory program, 7 semester):		Ū.

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

Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	 The following subjects/contents are treated: history of concrete construction mechanical and physical-chemical properties of concrete and steel bond between concrete and reinforcement concepts for dimensioning, limit state models, structural safety design of linear members for tension and bending with/without axial force
Literature	 Download der Unterlagen zur Vorlesung über Stud.IP! Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010 König G., Tue N.: Grundlagen des Stahlbetonbaus, 3. Auflage, Teubner-Verlag, 2008 Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerk nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011 Fingerlos F., Hegger J., Zilch K.: Eurocode 2 für Deutschland. Berlin 2016 Dahms KH.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 Grasser E., Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen v Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sof Berlin 1978

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

Courses					
Title			Тур	Hrs/wk	СР
Structural Analysis II (L067 Structural Analysis II (L0674			Lecture Recitation Section (large)	2 2	3 3
Module Responsible	Prof. Uwe Starossek				
Admission Requirements	None				
Recommended Previous Knowledge	A Structural Apply	ations I			
Educational Objectives	After taking part succe	essfully, students have read	ched the following learning	results	
Professional Competence			idents can express the ba	sic aspects	of linear fram
Knowledge	2				
Skills	construct influence line		e students are able to ana e plane and spatial frame a		
Personal Competence	1 9				
	Students can				
Social Competence	 defend their own promote the science 	bject-specific and interdise n work results in front of o entific development of coll ey can give and accept pro	thers	cism	
	enabled to self-assess		k assignments. Due to the ring the lecture period, alre		dback, they a
Autonomy					
	Independent Study Tim	ne 124, Study Time in Lect	ure 56		
		ne 124, Study Time in Lect	ure 56		
Workload in Hours	6 Compulsor B onus	ne 124, Study Time in Lect Form Written elaboration	Description Hausübungen mit	,	etreut durc
Workload in Hours Credit points Course achievement	6 CompulsorBonus No 10 %	Form	Description		etreut durc
Workload in Hours Credit points Course achievement	6 CompulsorBonus No 10 % Written exam	Form	Description Hausübungen mit		etreut durc

Course L0673: Structur	al 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	 Linear structural analysis: statically indeterminate systems force method slope-deflection method for sway and non-sway frames general displacement method and finite element method
Literature	Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 - Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004

irse L0674: Structural Analysis II			
Тур	Typ 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		

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
			-	-
Module Responsible	Prof. Herbert werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in tin	ne and frequency domain, Laplad	ce transform	
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic sysparticular explain properties of first a They can explain the dynamics of sim of frequency response and root locus They can explain the Nyquist stability They can explain the role of the phas They can explain the way a PID corresponse They can explain issues arising whimplemented digitally 	nd second order systems aple control loops and interpret of criterion and the stability margi e margin in analysis and synthes ontroller affects a control loop	lynamic prop ns derived fi is of control in terms o	perties in terr rom it. loops f its frequen
Skills	 Students can transform models of lirvice versa They can simulate and assess the bele They can design PID controllers with the they can analyze and synthesize simmersponse techniques They can calculate discrete-time appuse it for digital implementation They can use standard software tool tasks 	navior of systems and control loc the help of heuristic (Ziegler-Nich ple control loops with the help o roximations of controllers design	ops hols) tuning of root locus ned in contin	rules and frequen nuous-time a
Personal Competence	Students can work in small groups to jointly	solve technical problems, and e	xperimentall	ly validate th
Social Competence	controller designs Students can obtain information from pr experiment guides) and use it when solving	ovided sources (lecture notes,		
Autonomy	They can assess their knowledge in weekly o	. .	their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German progr Bioprocess Engineering: Core qualification: (Computer Science: Specialisation Computat Data Science: Core qualification: Elective Co Electrical Engineering: Core qualification: Co Energy and Environmental Engineering: Cor General Engineering Science (English pro Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Engineering: Compulsory	Compulsory onal Mathematics: Elective Com mpulsory e qualification: Compulsory gram, 7 semester): Specialisat rogram, 7 semester): Specialisation	pulsory ion Electrica lisation Civion Bioproces	al Engineerir il Engineerir ss Engineerir

Assignment for the Following Curricula General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 Materials in Engineering Sciences: 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 Theoretical 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 Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
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Assignment for the Following CurriculaFocus 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 Materials in 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 Naval Architecture: 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 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Sci
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Compulsory Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: 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

ourse L0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	
	Signals and systems
	 Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability
	Feedback systems
	 Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle
	Root locus techniques
	 Root locus plots Root locus design of PID controllers
Content	 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
	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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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 Steel Structures I (L0299) Steel Structures I (L0300)		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements				
Recommended Previous Knowledge		ry		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	 After passing this module students are able to give a summary of the security concept explain the priciples of the design proce describe and illustrate the bhaviour of m 	SS	on and bend	ing
Skills	Students can rate and apply the material steel They can use the security concept with respect They can check the ultimate limit state a compression and bending.	t to loads, forces and resistan	ces.	
Personal Competence				
	After participation of an optional course (b themselves in groups. They will be success according to design drawings.			
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement				
Examination				
Examination duration and scale	1 20 minutes			
Assignment for the Following Curricula		alification: Compulsory		-

Course L0299: Steel St	ructures 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	 Introduction to steel constructions Materials Design and security model Tension rods Beams (elsatic and plastic design Column design Bolted connections
Literature	 Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011 Band 1 Tragwerksplanung, Grundlagen Band 2 Verbindungen und Konstruktionen

Course L0300: Steel Structures I	
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0878: Applications in Civil and Environmental Engineering

-				
Courses				
Title		Тур	Hrs/wk	СР
Applied Structural Dynamics	s (L0791)	Lecture	2	2
Soil Laboratory Course (L04	99)	Practical Course	1	2
Building Information Modeling	ng (L1903)	Lecture	1	1
Building Information Modeli	ng (L1904)	Project-/problem-based Learning	2	2
Computational Analysis of S	tructures (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 (L04	170)	Lecture	2	2
Principles of Geomatics (L04	171)	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
Special topics of Civil- and E	nvironmental Engineering (L2411)		1	1
Special topics of Civil- and E	nvironmental Engineering 2 LP (L2412)		2	2
Special topics of Civil- and E	nvironmental Engineering 3LP (L2413)		3	3
Fire Protection and Preventi	on (L0472)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended				
Previous Knowledge	none			
	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
-	The students are at home doing with typic	cal applications of the study progra	amme.	
Knowledge				
	The students are able to use the methods			
	They are able to work in the learnt metho	ds into new forms of application in	dependently	/".
CL:II-				
Skills				
Personal Competence				
Social Competence	According to the course chosen students so, they can present, discuss and docume		nduct a pro	ject in teams
	According to the course chosen individu	al students can plan and docume	ont tacks on	d work flow
Autonomy	themselves or for the team.			
Workload in Hours	Depends on choice of courses			
Credit points	6			
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory			

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

Course L0499: Soil Lab	oratory Course
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	Fretallan dar Aucarbaitung – Raarbaitungezaitraum von / Wochen und ein Umtang von mavimal 500
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	 Field experiments Short lecture on laboratory tests soil analysis laboratory test soil clasification Creating a ground and foundation report
Literature	DIN-Taschenbuch 113, Erkundung und Untersuchung des Baugrundes

Hrs/wk 1 CP 1 Workload in Hours Independent Study Time 16, Study Time in Lecture 14 Examination form Schriftliche Ausarbeitung Examination duration and scale siehe Modulhandbuch Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBM, closedBM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic knowledge for the use of the software Allplan 2018: Basic settings (project administration, building structures, fileset structures, layers) Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, paterns, fills) Construction fundamentals 2D (floor concept,	Тур	Lecture
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, Thomas Kölzer Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and internatorange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic settings (project administration, building structures, fillest structures, layers) Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, patterns, fills) Construction fundamentals 2D (floor concept, floor manager, building structures) Walls and columns (height definitions, parameters, attributes,		
Examination Form Schriftliche Ausarbeitung Examination duration and scale siehe Modulhandbuch Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic knowledge for the use of the software Allplan 2018: Basic settings (project administration, building structures, fileset structures, layers) Construction fundamentals 2D (e. g. ine, circle, spline, ellipse, parallel etc.) Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, patterns, fills) Construction fundamentals 3D (floor concept, floor manager, building structures) Walls and columns	СР	1
Examination duration and scale siehe Modulhandbuch Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic knowledge for the use of the software Allplan 2018: • Basic settings (project administration, building structures, fileset structures, layers) • Construction fundamentals 2D (e.g. line, circle, spline, ellipse, parallel etc.) • Modifying of construction elements (e.g. copy, mirror, intersect, fillet etc.) • Dimensioning and text adding of designed elements and structures) • Construction fundamentals 3D (floor concept, floor manager, building structures) • Walls and columns (height definitions, parameters, attributes, format properties) • Slabs (height definitions, paramete	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer Prof. Frank Schmidt-Döhl, Thomas Kölzer Language DE Cycle WiSe/SoSe Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic settings (project administration, building structures, fileset structures, layers) Content Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.) Modifying of areas (hatchings, patterns, fills) Construction fundamentals 2D (floor concept, floor manager, building structures) Walls and columns (height definitions, parameters, attributes, format properties) Slabs (height definitions, parameters, attributes, format properties) Slabs (height definitions, parameters, damodows) Stairs and r		
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Cycle WiSe/SoSe Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic knowledge for the use of the software Allplan 2018: Basic settings (project administration, building structures, fileset structures, layers) Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, parterns, fills) Construction fundamentals 3D (floor concept, floor manager, building structures) Walls and columns (height definitions, parameters, attributes, format properties) Slabs (height definitions, parameters, attributes, format properties) Use of libraries (u. a. furnitures, surroundings etc.) Opening Elements and SmartParts (doors and windows) Stairs and ramps (stair wizard, IFC-Ramp) Roof frame and roof covering (custom planes, parameters, attributes, format properties) Attributes and characteristic values (allocations and modifications) Export and Import of IFC-Data (basics, floor allocation, fileset selection)	Lecturer	Prof. Frank Schmidt-Döhl, Thomas Kölzer
Basic knowledge of Building Information Modeling: Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic settings (project administration, building structures, fileset structures, layers) Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, patterns, fills) Construction fundamentals 3D (floor concept, floor manager, building structures) Walls and columns (height definitions, parameters, attributes, format properties) Use of libraries (u. a. furnitures, surroundings etc.) Opening Elements and SmartParts (doors and windows) Stairs and ramps (stair wizard, IFC-Ramp) Roof frame and roof covering (custom planes, parameters, attributes, format properties) Attributes and characteristic values (allocations and modifications) Export and Import of IFC-Data (basics, floor allocation, fileset selection)	Language	DE
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Generating of printable drawings (layouts, scales, page settings)		 Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) Current standards and guidelines (national and international standardisation, structures) Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) Object oriented modeling (requirements, structure, classification, parts catalogues) BIM-Implementation (structures, cycles, professions, job profiles, execution plan) BIM-Tools (software, hardware, application areas) Execution examples (national and international construction projects) Basic knowledge for the use of the software Allplan 2018: Basic settings (project administration, building structures, fileset structures, layers) Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.) Dimensioning and text adding of designed elements and structural components Generating of areas (hatchings, patterns, fills) Construction fundamentals 3D (floor concept, floor manager, building structures) Walls and columns (height definitions, parameters, attributes, format properties) Use of libraries (u. a. furnitures, surroundings etc.) Opening Elements and SmartParts (doors and windows) Stairs and ramps (stair wizard, IFC-Ramp) Roof frame and roof covering (custom planes, parameters, attributes, format properties) Attributes and characteristic values (allocations and modifications) Export and Import of IFC-Data (basics, floor allocation, fileset selection) Generating of sections and views (architecturial sections and associative sections)

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

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

	ction in Statitics with R
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	
Examination duration and scale	60 min
Lecturer	Dr. Joachim Behrendt
Language	DE
Cycle	WiSe
	Introduction to R
	Graphics with R
	Descriptive Statistic (Boxplot, Percentiles, outliers)
	Propability (Combinatorics, relative frequency, dependand probability)
Content	random numbers and distibutions (confidence interval, uniform and discrete distributions, tes distributions (t-F-X ² -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)
Literature	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
	von Toutenburg, Helge 2008
	http://dx.doi.org/10.1007/978-3-540-77510-2 R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran. project.org/doc/contrib/Short-refcard.pdf Grafiken und Statistik in R von Andreas Plank Nachschlage Skript mit Beispielen: http://www.geo.f 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	Klausur
Examination duration and scale	siehe Vorlesung
Lecturer	Dr. Joachim Behrendt
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0470: Principle	es of Geomatics
•	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and scale	ischriffliche Ausarbeitunden zu allen führ Unlinden, dat Testklausur
Lecturer	Prof. Peter Andree
Language	DE
Cycle	SoSe
Content	 Overview of geomatics in general Units of measurements Generating of topographical maps Basic surveying instruments and handling Geodetic surveying lines and verification of measurements Methods of horizontal survey Components of geodetic surveying instruments Height determination Setting out points Topographical survey Directions and angles Determination of coordinates Traversing Basics on surveying and positioning with GNSS
Literature	Andree, P.:Grundlagen der Geomatik (Skript)Resnik, B. / Bill, R.: verlagVermessungskunde für den Planungs- Bau- und Umweltbereich, Wichmann- verlagWitte, B. / Sparla, P.: Wichmann-VerlagVermessungskunde und Grundlagen der Statistik für das Bauwesen,

ourse L0471: Principles of Geomatics	
Тур	Recitation Section (small)
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	
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	
	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	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB 	
Literature	 Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005 	

Course L1744: Practica	l Course in Drinking Water Chemistry			
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	 !Max.12 students! The students learn basic experimental work in the laboratory. The experiments give an overview about the most important chemical analysis methods of drinking water. This includes sampling, photometric measurement, complexometric titration as well as acid/base titration. The experiments are strongly related to the processes in drinking water treatment and water distribution (e. g. removal of iron and manganese, softening and conditioning). Instrumental analytics is not subject of this practical course. 1. Day: Introduction, safety instructions 2. Day: Electrical conductivity, saturation with respect to calcite, hardness 3. Day: Organic carbon, iron, acid and base neutralization capacity 4. Day: Writing protocols of experiments and presentations 5. Day: Evaluation of the protocols and presentations, final discussion 			
Literature	Siehe Skript. See Script.			

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

Course L2411: Special topics of Civil- and Environmental Engineering				
Тур				
Hrs/wk				
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Examination Form	aut FSPO			
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt			
Lecturer	Dozenten des SD B			
Language	DE/EN			
Cycle	WiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	Die Literatur wird kurzfristig festgelegt.			

Course L2412: Special topics of Civil- and Environmental Engineering 2 LP				
Тур				
Hrs/wk				
СР	2			
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28			
Examination Form	aut FSPO			
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt			
Lecturer	Dozenten des SD B			
Language	DE/EN			
Cycle	WiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	ie Literatur wird kurzfristig festgelegt.			

Course L2413: Special	Course L2413: Special topics of Civil- and Environmental Engineering 3LP		
Тур			
Hrs/wk	3		
СР			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Examination Form	aut FSPO		
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt		
Lecturer	Dozenten des SD B		
Language	DE/EN		
Cycle	WiSe/SoSe		
Content	The course occurs only if required. The content is defined at short notice.		
Literature	Die Literatur wird kurzfristig festgelegt.		

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

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

Module M0755: G	eotechnics II				
Courses					
Title			Тур	Hrs/wk	СР
Foundation Engineering (L0			Lecture	2	2
Foundation Engineering (L0) Foundation Engineering (L1)			Recitation Section (large) Recitation Section (small)	2 2	2 2
	-		Recitation Section (Smail)	Z	Z
Module Responsible					
Admission Requirements	None				
	Modules:				
Recommended Previous Knowledge	Mechanics I-IIGeotechnics I				
Educational Objectives	After taking part succe	ssfully, students hav	ve reached the following learning	results	
Professional		<u>,</u>			
Competence					
Knowledge	The students know the basic principles and methods which are required to verificate the stability geotechnical structures.				
	After successful comple	etion of the module	the students are able to:		
Skills	 verificate the stability and usability of foundations, know individual methods of ground improvement and apply them in their range of application, design retaining walls. 				
Personal Competence					
Social Competence					
Autonomy					
	Independent Study Tim	e 96 Study Time in	Lecture 84		
Credit points					
Course achievement	CompulsorBonus	Form Attestation	Description		
Examination					
Examination duration and scale	60 minutes				
Assignment for the Following Curricula					

urse L0552: Foundat	ion Engineering		
Тур	cture		
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/SoSe		
Content	 Shallow foundations Pile foundations Ground improvement Retaining walls Underpinning Groundwater Conservation Cut-off Walls 		
Literature	 Vorlesung/Übung s. www.tu-harburg.de/gbt Grabe, J. (2004): Bodenmechanik und Grundbau Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau Grundbau-Taschenbuch, neueste Auflage 		

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

Courses						
Title			Тур	Hrs/wk	СР	
Computer Engineering (L032	21)		Typ Lecture	пі 5/ w к З	4 4	
Computer Engineering (L032	24)		Recitation Section (small)	1	2	
Module Responsible	Prof. Heiko Falk					
Admission Requirements	None					
Recommended	Basic knowledge in ele	Basic knowledge in electrical engineering				
Previous Knowledge ducational Objectives	After taking part succe	essfully, students hav	e reached the following learning	results		
Professional		•				
Competence	This module deals wit from the assembly-lev • Introduction	el programming down logic: Gates, Boo	the functionality of computing s n to gates. The module includes lean algebra, Boolean funct	the following	topics:	
Knowledge	 Sequential logic Technological for Computer arithmediation Basics of computer Memories: Memories 	:: Flip-flops, automata bundations metic: Integer additio uter architecture: Pro- ory hierarchies, SRAN O from the perspect	n, systematic hardware design n, subtraction, multiplication and gramming models, MIPS single-c A, DRAM, caches cive of the CPU, principles of	ycle architec		
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify to internal structure and the physical composition of computer systems. The students can analyze, he highly specific and individual computers can be built based on a collection of few and simp components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the 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 abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate t					
Personal Competence Social Competence	feasible options. Students are able to se	olve similar problems	have on an entire system's pr alone or in a group and to prese ge from specific literature and	ent the result	s accordingly	
Autonomy	with other classes.		<u>.</u>			
Workload in Hours	Independent Study Tir	ne 124, Study Time ir	n Lecture 56			
Credit points	6					
Course achievement	CompulsorBonus Yes 10 %	Form Excercises	Description			
Examination						
Examination duration and scale	90 minutes, contents o	of course and labs				
	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering General Engineering Compulsory	Science (German pro Science (German pro Science (German pro Science (German pro Science (German pro Science (German pro Science (German pro ompulsory	program, 7 semester): Specia gram, 7 semester): Specialisat program, 7 semester): Specialisa gram, 7 semester): Specialisat gram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio gram, 7 semester): Specialisatio	ion Bioproces isation Nava ation Electric ion Biomedic on Energy an sation Proces ion Mechanic	ss Engineerin al Architectur al Engineerir al Engineerir d Enviroment ss Engineerir al Engineerir	

	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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	Computer Science: Core gualification: Compulsory
Assignment for the	Data Science: Core qualification: Elective Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
-	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	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 Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	5 5 1 5
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: 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	 Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output 			
Literature	 A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. 			

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

Module M0631: Reinforced Concrete Structures II							
Courses Title			Тур	Hrs/wk	СР		
Project Concrete Structures II (L0894)			Project Seminar	1 1	1		
Concrete Structures II (L034	48)		Lecture	2	3		
Concrete Structures II (L034	19)		Recitation Section (large) 2	2		
	Prof. Günter Rombach						
Admission Requirements	None						
Recommended Previous Knowledge	 Knowledge of loads on structures and combination of actions Basics of safety format are required. Knowledge in design of beams and columns for ultimate limit state Modules: Reinforced Concrete Structures I, Structural Analysis I+II, Mechanics I+II 						
Educational Objectives	After taking part succe	essfully, students ha	ave reached the following learnin	g results			
Professional							
Competence	The students know the	o basis principlos w	hich are required for decign of re	inforced cond	roto structuros		
Knowledge	The students know the basic principles which are 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	 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.). The students can estimate the member forces of simple slabs. The students know the content and the layout of a structural analysis 						
Personal Competence							
Social Competence	Cooperation in a project work, where they design in a team a real concrete building and present the results at the end.						
Autonomy							
	Independent Study Tir	ne 110, Study Time	in Lecture 70				
Credit points Course achievement	CompulsorBonus	Form	Description				
Examination	Yes None Written exam	Excercises					
Examination Examination duration and scale	120 minutes						
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory						
Course L0894: Project	Concrete Structures	II					
Тур	Project Seminar						
	/						

Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Björn Schütte		
Language	DE		
Cycle	WiSe		
Content	ent Design of a truss structure		
Literature	Skript zur Lehrveranstaltung "Stahlbetonbau II"		

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

Typ	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 M0728: H	ydromechanics and Hydrology			
Courses				
Title		Тур	Hrs/wk	СР
Hydrology (L0909)		Lecture	1	1
Hydrology (L0956)		Project-/problem-based Learning	1	1
Hydromechanics (L0615)		Lecture	2	2
Hydromechanics (L0616)		Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
	Mathematics I, II and III			
Recommended Previous Knowledge	Mechanics I und II			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional				
Competence				
Knowledge	The students are able to define the basic terms of hydromechanics, hydrology groundwater 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 o a unit-hydrograph.			
	The students are able to apply the fundamental formulations of hydromechanics to basic pract problems. Furthermore, they are able to run, explain and document basic hydraulic experiments.			
Besides, they are able to apply basic hydrological approaches and methods to problems. The students have the capability to exemplarily apply simple reservoir/st unit-hydrograph to given problems.				ple hydrologica ge models and a
	In addition, the basic concepts of field-measurements of hydrological and hydrodynamic values of described and the students are able to perform, analyze and assess respective measurements.			
Personal Competence				
Social Competence	The students are able to work in groups in a goal-orientated, structured manner. They can explain the			
Autonomy	Students are capable of organising their individual work flow to contribute to the conduct or experiments and to present discipline-specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German progr Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English progra Compulsory	fication: Compulsory		5

Course L0909: Hydrolo	av
	Lecture
,,,	
Hrs/wk	
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 and groundwater hydrology: Hydrological cycle Data acquisition in hydrology Data analyses and statistical assessment Statistics of extremes Regionalization methods for hydrological values rainfall-run-off modelling on the basis of a unit hydrograph concept
Literature	Maniak, U. (2017). Hydrologie und Wasserwirtschaft: Eine Einführung für Ingenieure. Springer Vieweg. Skript "Hydrologie und Gewässerkunde"

Course L0956: Hydrolog	gy
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of Hydrology: • Hydrological cycle • Data acquisition • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde

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

Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	 Characteristics of fluids Hydrostatics Kinematics of flows, laminar and turbulent flows Conservation laws Conservation of mass Conservation of Energy Momentum Equation Application of conservation laws to flow conditions
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.

Typ	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	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (L0		Lecture	1	1
Groundwater Hydrology (L0 Water Management and Wa		Recitation Section (large) Lecture	1 2	2 3
5		Lecture	۷	J
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge		I, Chemistry		
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	Students are able to define terms of the hydrologic cycle and also parameters to identify the wat 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 hydraulid Fundamentals of solute transport can be reflected.			
Skills	Students are able to use fundamental relationships of hydrology and water management for t solution of practical issues. They are in a position to rate water quality data and to set up hydrologic water balances. They are able to construct ground water contour lines and streamlines on the basis head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydrau conductivities and storage coefficients.			
Personal Competence				
Social Competence	Students are able to help each other s	olving case studies.		
Autonomy	Are not imparted in this module.			
Workload in Hours	Independent Study Time 124, Study Ti	me in Lecture 56		
Credit points	6			
Course achievement				
	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Electi Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Electi Compulsory			

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

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

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

Courses				
Title Basics in Structural Design	(L0209)	Typ Project-/problem-based	Hrs/wk	CP 4
Basics of Structural Design Basics in Structural Design		Learning Lecture Recitation Section (large)	2 1	1 1
Module Responsible	Thomas Kölzer			
Admission Requirements	None			
Recommended Previous Knowledge		ng Materials and Building Physics"		
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence		on" module students are able		
Knowledge	 to define the basics of building regulations law to explain load effects and associated concepts to describe overriding conventions of the construction industry to specify typical building components to distinguish between different possibilities of load bearing behaviour and risks due to lack or stability to explain the main objectivs of fire control. 			
Skills	develop stability and foundationuse BIM software	g conventions ng of basic building components		
Personal Competence	After attending the course students are	able		
Social Competence	 to work in a team and to persent to use the feedback from other s to give a feedback to other stude 	tudents to improve the own results		
Autonomy	and tests (STUD.IP)	able owledge with the help of weeekly p ent parts, to deduce the needed know		
	Independent Study Time 110, Study Tir	ne in Lecture 70		
Credit points Course achievement				
	Subject theoretical and practical work			
	Desing, Construction and prelimnary de	sign in a written form		
Assignment for the Following Curricula	General Engineering Science (Germa Compulsory	an program, 7 semester): Specia Core qualification: Compulsory		

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

ourse L0205: Basics of Structural Design				
Тур	Lecture			
Hrs/wk	2			
СР				
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28			
	Thomas Kölzer			
Language	DE			
Cycle				
Content	 Basics of building regulation laws Foundation of buildings Sealing of basements facades Ceilings Roofs Windows, doors and post-and-beam constructions Staircases Basics of strucural engineering design Structural fire prevention Optional tests on STUD.IP 			
Literature	 Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung Schneider Bautabellen (Hrsg. A. Albert) 23., überarbeitete Aufl. ISBN 978-3-8462-0880-9 Reguvis Fachmedien GmbH, 2018 Neumann, Dietrich (Hestermann, U.; Rongen, L.; Weinbrenner, U.) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden: Vieweg+Teubner Verlag, 2006 Frick, Otto (Knöll, K.; Neumann, D.; Hestermann, U.; Rongen, L.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden: Vieweg+Teubner Verlag, 2008 Dierks, Klaus (Wormuth, R.) Baukonstruktion ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007 Neufert, Ernst (Kister, J.) Bauentwurfslehre (42. Aufl.) ISBN: 978-3-8348-0732-8 Wiesbaden : Vieweg + Teubner, 2018 Wendehorst, Reinhard (Wetzell, O. W.,; Baumgartner, H.,) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8			

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

Courses				
Title Management Tutorial (L088: Introduction to Management		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission	None			
Previous Knowledge	Basic Knowledge of Mathematics and Business			
	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence	After taking this module, students know the impo			
Knowledge	 Management, from Planning and Organisation to Marketing and Innovation, and also to Investment ar 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 explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supp chain management, organization and human ressource management, information management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematic Finance state basics from accounting and costing and selected controlling methods. 			
Skills	 Students are able to analyse business units with respect to different criteria (organization, objective: strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 			
Personal Competence	Studente era able ta			
Social Competence	 Students are able to work successfully in a team of students to apply their knowledge from the lecture report on the project to communicate appropriately and to cooperate respectfully with their fellow s 		roject and w	rrite a cohere
Autonomy	 Students are able to work in a team and to organize the team th to write a report on their project. 	nemselves		
	Independent Study Time 110, Study Time in Lectu	are 70		
Credit points				
Course achievement				
Examination duration	Subject theoretical and practical work several written exams during the semester			
	General Engineering Science (German program, 7 Civil- and Environmental Engineering: Core qualifi Civil- and Environmental Engineering: Specialisati Civil- and Environmental Engineering: Specialisati Civil- and Environmental Engineering: Specialisati Bioprocess Engineering: Core qualification: Computer Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compuls Energy and Environmental Engineering: Core qualification: Compuls	cation: Compulsory on Civil Engineering: Electi on Water and Environment on Traffic and Mobility: Ele ulsory v sory	ve Compulso :: Elective Co	ory ompulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil 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 General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 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 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 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 Eng
Assignment for the Following CurriculaGeneral Engineering Science (English program, 7 semester): Specialisation Civil 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 General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 Energy Systems: 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
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 General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 Energy Systems: 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 Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: 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 Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 Energy Systems: 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
Assignment for the Following CurriculaGeneral Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 Energy Systems: 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 Energy Systems: 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
Assignment for the Following Curricula Assignment for the Following Curricula
General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Assignment for the Following Curricula General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Assignment for the Following Curricula General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Assignment for the Following Curricula 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
Assignment for the Following Curricula 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
Following Curricula General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
Following Curricula 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
pomorai Engineening Science (English program, 7 semester), specialisation Methaliltar 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 Naval Architecture:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Computational Science and Engineering: Core gualification: Compulsory
Logistics and Mobility: Core qualification: Compulsory
Mechanical Engineering: Core gualification: Compulsory
Mechatronics: Core gualification: Compulsory
Orientierungsstudium: Core gualification: Elective Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core gualification: Compulsory
Process Engineering: Core qualification: Compulsory

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

urse L0880: Introduc	tion to Management		
Тур	Lecture		
Hrs/wk	3		
СР	3		
	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language			
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information Management Definitions as information, information systems, aspects of data security and strategi information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects 		
Literature	 Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. 		

Module M0686: S	anitary Engineering l			
Courses				
Title Wastewater Disposal (L0276 Wastewater Disposal (L0276 Drinking Water Supply (L036 Drinking Water Supply (L036	3) 06)	Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2 1	CP 2 1 1 2
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	 Basic knowledge on Chemistry and Biology Hydraulics of pipe systems and open channels Basic knowledge on water management: water quantity and water quality Basic knowledge on Environmental Legislation: Federal Water Act 			
Educational Objectives	After taking part successfully, students have r	eached 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 o 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 their own to improve the existing water related infrastructures, systems and concepts.			
Personal Competence Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are able to form concepts on their own to optimize urban water infrastructure processes. Therefore they can acquire appropriate knowledge when being given some clues or information with regard to the approach to problems (preparation and follow-up of the exercises).			
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core qu Civil- and Environmental Engineering: Core qu General Engineering Science (English progra Compulsory	alification: Compulsory alification: Compulsory	Ū.	-

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

Course L0278: Wastew	ourse L0278: Wastewater Disposal		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	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		

urse L0306: Drinking	y Water Supply		
Тур	Lecture		
Hrs/wk	2		
СР	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst		
Language	DE		
Cycle	SoSe		
Content	The lecture on drinking water supply provides students with a basic understanding of the entire wat supply system, encompassing water catchment, water treatment including pump systems, wat 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 wat resources and will be able to design groundwater wells. Students learn how to determine wate demand and derive planning values for designing the different elements of a water supply system (e. firefighting requirements). The functions of reservoirs, their design and arrangement in the wat 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 presentation of the essential mechanisms and layout parameters for sedimentation, filtratio coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange ar 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. Auf Teubner Verlag Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayr Taschenbuch der Wasserversorgung. 16. Auf Springer-Vieweg Verlag. DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, r CD-ROM: Band 6 (2003).		

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

Courses				
Title		Тур	Hrs/wk	СР
Hydraulics (L0957)		Lecture	1	1
Hydraulics (L0958)		Project-/problem-based Learning	1	1
Hydraulic Engineering (L095	59)	Lecture	2	2
Hydraulic Engineering (L096	50)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Hydraulic Engineering I			
Educational Objectives	After taking part successfully, students have	reached the following learning	g results	
Professional Competence				
Knowledge	Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able explain the application of basic hydrodynamic formulations (conservation laws) to practical hydrau engineering problems. Besides this, the students can illustrate important tasks of hydraulic engineeri and give an overview over river engineering, flood protection, hydraulic power engineering a waterways engineering.			
Skills	The students are able to apply hydraulic engineering methods and approaches to basic practi problems and design respective hydraulic engineering systems. Besides this, they are able to use a apply established approaches of hydraulics and determine water surfaces of channel flows, influence of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system. Furthermo they are able to run, explain and document basic hydraulic experiments.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems. Additionaly, they will he able to work in team with engineers of other disciplines in a goal-orientated, structured manner. The can explain their results by use of peer learning approaches.			
Autonomy	The students will be able to independently extend their knowledge and apply it to new problem Furthermore, they are capable of organising their individual work flow to contribute to the conduct experiments and to present discipline-specific knowledge.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	n Written exam			
	The duration of the examination is 2 hours. understanding of the lecture contents and c		s with respec	ct to the gene
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Elect Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elect Compulsory			

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

urse L0958: Hydraul	rse L0958: Hydraulics				
Тур	Project-/problem-based Learning				
Hrs/wk	1				
СР	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	rof. Peter Fröhle				
Language	DE				
Cycle	WiSe/SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Тур	Lecture			
Hrs/wk				
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
	of. Peter Fröhle			
Language	DE			
	WiSe/SoSe			
Content	 Fundamentals of hydraulic engineering Introduction and hydrological cycle River engineering Regime theory of natural rivers Sediment transport Regulation of rivers Bank protection / protection of river bed Tidal rivers Flood protection Dikes Flood contraol basins Hydraulic power Inland waterways engineering waterways Locks and ship lifts Fish passages Nature-oriented hydraulic engineering 			
Literature	Strobl, T. & Zunic, F: Wasserbau, Springer 2006 Patt, H. & Gonsowski, P: Wasserbau, Springer 2011			

Course L0960: Hydraul	ourse L0960: Hydraulic Engineering			
Тур	Project-/problem-based Learning			
Hrs/wk	1			
СР				
Workload in Hours	ndependent Study Time 46, Study Time in Lecture 14			
Lecturer	rof. Peter Fröhle			
Language	DE			
Cycle	WiSe/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 Introduction into Process En Fundamentals of material en		gineering (L0829)	Typ Lecture Lecture	Hrs/wk 2 2	CP 1 2
Module Responsible	Prof. Michael Schlüter				
Admission Requirements	None				
Recommended Previous Knowledge	none				
Educational Objectives	After taking part succ	essfully, students ha	ve reached the following l	earning results	
Professional Competence	After passing this mod	dule the students ha	ve the ability to:		
Knowledge			tant fields on process and different fields in process o		ring,
Skills	 After passing this module the students should have the ability to: list and outline the most important fields of process engineering, name the most important working approaches or methods of the different fields of proces engineering, read and prepare an engineering drawing, explain the most important technologies for wastewater and exhaust air treatment scheme typical chemical and biotechnological processes independently with the aid of pointers. 				
Personal Competence					
Social Competence	 The students are able to work out results in groups and document them, provide appropriate feedback and handle feedback on their own performance constructively. 				
Autonomy			ogress of learning by the Bioprocess Engineering.	mselves and to delil	perate their lac
Workload in Hours	Independent Study Ti	me 34, Study Time in	n Lecture 56		
Credit points	3				
Course achievement	CompulsorYes5 %	Form Written elaboratio	Description		

and scale	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
Assignment for the	Conoral Engineering Science (English program 7 comester); Specialisation Process Engineering;
Following Curricula	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0829: Introduc	tion 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				
СР				
Workload in Hours	dependent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Marko Hoffmann			
Language	DE			
Cycle	WiSe			
Content	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials 			
Literature	 Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführun Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W.,Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012. 			

Courses					
Title			Typ	Hrs/wk	СР
Computer Engineering (L03)	21)		Typ Lecture	нг 5/ w к 3	4 4
Computer Engineering (L03	24)		Recitation Section (small) 1	2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended	Basic knowledge in ele	ectrical engineering			
Previous Knowledge	After taking part succe	sectully students have	ve reached the following learnin	a results	
Professional		essiuny, students nav	ve reached the following learnin	gresuits	
Competence					
Knowledge	from the assembly-lev Introduction Combinational r orbinational r Sequential logic Technological for Computer arithm Basics of compu	el programming dow logic: Gates, Boo networks :: Flip-flops, automations metic: Integer additio	the functionality of computing in to gates. The module includes blean algebra, Boolean func a, systematic hardware design on, subtraction, multiplication an ogramming models, MIPS single- M. DRAM. caches	s the following tions, hardw nd division	topics: are synthes
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify to internal structure and the physical composition of computer systems. The students can analyze, he 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 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 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 abstractil layers from the assembly language down to gates. This way, they will be enabled to evaluate t impact that these low abstraction levels have on an entire system's performance and to proportions.				
Personal Competence		- 1 ¹ - ¹			
Social Competence	Students are able to s	olve similar problems	s alone or in a group and to pres	sent the result	s accordingly
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes.				
Workload in Hours	Independent Study Tir	ne 124, Study Time i	in Lecture 56		
Credit points	6				
Course achievement	Compulsor B onus	Form	Description		
Examination	Yes 10 %	Excercises			
Examination duration					
and scale	90 minutes, contents o	of course and labs			
		Science (German	program, 7 semester): Speci	alisation Com	puter Scienc
	Compulsory General Engineering S	Science (German pro	ogram, 7 semester): Specialisa	tion Bioproce	ss Engineerin
	Compulsory				
	Compulsory	Science (German	program, 7 semester): Specia	alisation Nava	al Architectui
	General Engineering	Science (German	program, 7 semester): Spec	ialisation Civ	il Engineerin
		Science (German pi	rogram, 7 semester): Specialis	ation Electric	al Engineerin
	Compulsory General Engineering S	Science (German pro	ogram, 7 semester): Specialisa	tion Biomedic	al Engineerin
	Compulsory General Engineering S	Science (German pro	ogram, 7 semester): Specialisat	ion Energy an	d Enviroment
	Engineering: Compuls	ory			
	General Engineering	Science (German b	program, 7 semester): Special	ISALIUIT FIUCES	S LIQUEEII.
	Compulsory		ogram, 7 semester): Specialisa		5

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

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

Course L0324: Compute	urse 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 Process	· ,		Typ Lecture Recitation Section (la	Hrs/wk 2 rge) 2	CP 4 2
Module Responsible	Prof. Michael Schlüter				
Admission Requirements	None				
Recommended Previous Knowledge	Working with for	anics I+II nodynamics I+II rce balances	l differential equations		
Educational Objectives	After taking part succe	essfully, students ha	ave reached the following lear	ning results	
Professional Competence				-	
Knowledge	 explain the difference between different types of flow give an overview for different applications of the Reynolds Transport-Theorem in process engineering explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundar conditions 				
Skills	 The students are able to describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitativ solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering 				
Personal Competence					
Social Competence	 The students are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and able to work together on subject related tasks in small groups. They are able to present the results effectively in English (e.g. during small group exercises) are able to work out solutions for exercises by themselves, to discuss the solutions orally and t present the results. 				
	The students are able	to			
Autonomy					
Workload in Hours	Independent Study Tin	ne 124, Study Time	in Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus Yes 5 %	Form Midterm	Description		
Examination	Written exam				
Examination duration and scale	3 hours				
Assignment for the Following Curricula	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 Energy and Environment Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environment Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				

Process Engineering: Core qualification: Compulsory

Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	 fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematisce Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömunger Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethode Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgändichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 201

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

Module M0757: B	iochemistry and Microbiology				
Courses					
Title Biochemistry (L0351)		Typ Lecture	Hrs/wk 2	CP 2	
Biochemistry (L0728)		Project-/problem-based Learning	1	1	
Microbiology (L0881)		Lecture	2	2	
Microbiology (L0888)		Project-/problem-based Learning	1	1	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results		
Professional Competence					
	At the end of this module the students can:				
	- explain the methods of biological and biochemical research to determine the prop biomolecules			e properties o	
	- 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 stud	ents			
Social Competence	- to introduce their own knowledge and to argue their view in discussions in teams				
	- to divide a complex task into subtasks, solve the	ese and to present the com	bined result	S	
Autonomy	The students are able to present the results of their subtasks in a written report				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84			
Credit points	6				
Course achievement					
Examination					
Examination duration and scale	90 min				
Assignment for the Following Curricula	General Engineering Science (German program, Compulsory Bioprocess Engineering: Core qualification: Comp General Engineering Science (English program, Compulsory Orientierungsstudium: Core qualification: Elective Technomathematics: Specialisation III. Engineerir	ulsory 7 semester): Specialisati c Compulsory	on Bioproce	-	

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

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

Course L0881: Microbio	blogy
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	 The procaryotic cell evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships extremophiles biotechnology
Literature	 Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €) Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €) Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €) http://www.grundlagen-der-mikrobiologie.icbm.de/

Irse L0888: Microbio	Project-/problem-based Learning
Hrs/wk	
СР	
	Independent Study Time 16, Study Time in Lecture 14
	Dr. Christian Schäfers
Language	
Cycle	
Content	 The procaryotic cell evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships extremophiles biotechnology
Literature	 Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €) Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemal "Brock", Pearson Verlag (89,95 €) Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €) http://www.grundlagen-der-mikrobiologie.icbm.de/

Courses				
Title Phase Equilibria Thermodyn Phase Equilibria Thermodyn Phase Equilibria Thermodyn	amics (L0140)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1 1	CP 2 2 2
		Recitation Section (large)	T	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermodyn	amics I and II		
Educational Objectives	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	 Starting from the very basics of therm describe thermodynamic equilibria. They learn how state variables are influ quantitatively describe these properties Moreover, the students learn how pha phenomena may occur if different Furthermore the fundamentals of react For different phase equilibria, several shown and the necessary knowledge for the student of the	enced by the mixing of compose se equilibria can be described phases (vapor, liquid, solid on equilibria are taught. examples relevant for differe	ounds and le mathemati d) coexist ent kinds of	earn concepts cally and whi in equilibriu f processes a
Skills	 Applying their knowledge, the stude determination of the equilibrium state at The students know models which can be equilibrium state and they are able to s For specific applications, they are properties of compounds as well as mo Beside pure compound properties the mixtures. The students know how to visualize ph the occurring phenomena. Based on their knowledge, the student the basis for many separation and reactions of the student of the basis for many separation and reactions. 	and know how to simplify these be used to determine the prop olve the resulting mathematic able to self-reliantly find no del parameters in literature so e students are capable of de ase equilibria graphically and as are able to understand func	e equations perties of th al relations. ecessary pl urces. escribing th they know h damental co	meaningfully. e system in tl hysico-chemic e properties how to interpr
Personal Competence				
-	The students are able to work in small grou	ps, to solve the correspondin	g problems	and to prese
Social Competence Autonomy	 them oraly to the tutors and other students The students are able to find necessa judge their quality. During the semester the students are exercises. Based on this knowledge the 	nry information self-reliantly in e able to check their learnin	n literature g progress	sources and continuously
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Course achievement				
	Written exam			
Examination duration	120 minutes; theoretical questions and calcula	ations		
Assignment for the	General Engineering Science (German prog Compulsory General Engineering Science (German progr Compulsory Bioprocess Engineering: Core qualification: Co General Engineering Science (English prog Compulsory	rram, 7 semester): Specialisa am, 7 semester): Specialisatio mpulsory	on Bioproce	ss Engineerin

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

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

Course L0140: Phase E	quilibria Thermodynamics
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	 Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O ´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005.

Course L0142: Phase Equilibria Thermodynamics				
Typ 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	 Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, binary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure 			
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. 			

Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432 Signals and Systems (L0433		Lecture Recitation Section (small)	3	4 2
		Recitation Section (Small)	Z	Z
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
•	Mathematics 1-3			
	The modul is an introduction to the theory of sigr by the moduls Mathematik 1-3 is expected. Furt series, Fourier transform, Laplace transform) is u	her experience with spectr		
Educational Objectives	After taking part successfully, students have read	hed the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usi 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 determine			
Skills	The students are able to describe and analyse of using methods of signal and system theory. The important properties such as magnitude and phe the impact of LTI systems on the signal properties are such as the signal properties.	ey can analyse and designate and analyse and designate and the second second second second second second second	n basic sys arity etc 1	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant infor control their level of knowledge during the lectu clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	m, 7 semester): Speciali n, 7 semester): Specialisa	sation Con ation Proce	nputer Scien ss Engineerin
	General Engineering Science (German program Compulsory General Engineering Science (German program,			5
	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program,	7 semester): Specialisatic	on Mechanio	al Engineerii
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compul General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Comp Computer Science: Core gualification: Compulsor	7 semester): Specialisatio sory 7 semester): Specialisatio 7 semester): Specialisatio ulsory y	on Mechanio on Mechanio	cal Engineerii cal Engineerii
Assignment for the Following Curricula	Electrical Engineering: Core qualification: Compu General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program	, 7 semester): Specialisat m, 7 semester): Speciali:	sation Com	puter Scien
	Compulsory	, i schiester, specialise	anon rioce	55 Engineelli

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

Courses						
Title Bioprocess Engineering - Fu Bioprocess Engineering- Fur Bioprocess Engineering - Fu	ndamentals (L0842)	se (L0843)	Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 2 2	CP 3 1 2	
				L	-	
Module Responsible Admission						
Requirements	None					
Recommended Previous Knowledge	none, module "organic	chemistry", module "fun	damentals for process engin	eering"		
Ţ	After taking part succe	ssfully, students have rea	ached the following learning	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 process in bioreactors can be explained. The students are capable to explain fundamental bioproce management, sterilization technology and downstream processing in detail. After successful completion of this module, students should be able to					
Skills	 corresponding p predict qualitati growth inhibition analyze bioproce distinguish betw aerobic as well biotechnical pro propose solution models to explore new k identify scientification 	arameters vely the influence of energy on the fermentation pro- esses on basis of stoichio veen scale-up criteria f as microaerobic) to co- blem as to complicated bioteco- constructed bioteco- const	or growth and substrate-up ergy generation, regeneration ocess metry and to set up / solve r for different bioreactors and compare them as well as chnological problems and to to apply the newly gained co industrial use and to formul is as well as results in a scier	n of redox netabolic flu d bioproces to apply th deduce the ontents ate solution	equivalents a ux equations ises (anaerol hem to curr e correspond s.	
Social Competence	teams to enhance the		should be able to debate to to their own opinions and ments.			
	After completion of this module participants will be able to solve a technical problem in a tea independently by organizing their workflow and to present their results in a plenum.					
Workload in Hours	Independent Study Tim	e 96, Study Time in Lect	ure 84			
Credit points	· · · · ·	, ,				
	CompulsorBonus	Compulsor B onus Form Description				
Course achievement	Yes 5 %	Subject theoretical practical work	and			
Examination	Written exam	P				
Examination duration and scale						
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory Bioprocess Engineering General Engineering Compulsory General Engineering S Compulsory Biomedical Engineering Biomedical Engineering	cience (German program g: Core qualification: Com Science (English program cience (English program g: Specialisation Artificial g: Specialisation Implants g: Specialisation Medical	am, 7 semester): Specialisa n, 7 semester): Specialisatio Organs and Regenerative M s and Endoprostheses: Electiv Technology and Control Theo	on Bioproce ation Proce on Bioproce edicine: Cor ve Compulso ory: Elective	ess Engineeri ss Engineeri ess Engineeri npulsory ory compulsory	

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

τνρ	Recitation Section (large)
Hrs/wk	
СР	
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	 Introduction (Prof. Liese, Prof. Zeng) Enzymatic kinetics (Prof. Liese) Stoichiometry I + II (Prof. Liese) Microbial Kinetics I+II (Prof. Zeng) Rheology (Prof. Liese) Mass transfer in bioprocess (Prof. Zeng) Continuous culture (Chemostat) (Prof. Zeng) Sterilisation (Prof. Zeng) Downstream processing (Prof. Liese) Repetition (Reserve) (Prof. Liese, Prof. Zeng)
Literature	siehe Vorlesung

Course L0843: Bioproce	ess Engineering - Fundamental Practical Course
Тур	Practical Course
Hrs/wk	2
СР	2
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						
Fitle				Тур	Hrs/wk	СР
Chemical Reaction Engineer	-			Lecture	2	2
Chemical Reaction Engineer Experimental Course Chemi				Recitation Section (large) Practical Course	2 2	2 2
-					L	-
Module Responsible Admission						
Requirements	None					
Recommended Previous Knowledge				-III, physical chemistry, teo	hnical therr	nodynamics I
			•	hed the following learning	results	
Professional Competence						
	The students are able out differences betwee to outline parts of isot	en thermodynamic hermal and non-isc	al and k	f chemical reaction engine inetical processes. The stu ideal reactors and to descu	idents have	a strong abil
	After successful compl	letion of the modu	le, stude	nts are able to:		
	- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,					
Skills	s - determine and compute stable operation points for these reactors ,					
	- conduct experiments	- conduct experiments on a lab-scale pilot plants and document these according to scientific guide				
Personal Competence						
Social Competence	After successful completition of the lab-course the students have a strong ability to organize themselfer 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. Student 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					
Course achievement	Compulsor₿onus Yes None	Form Subject theore practical work	etical a	Description and		
Examination						
Examination duration and scale	120 min					
	Compulsory General Engineering S Compulsory Bioprocess Engineerin Bioprocess Engineering General Engineering S Compulsory	Science (German g: Core qualificatic g: Core qualificatic Science (English p Science (English	program program pn: Comp program, progran	ulsorý 7 semester): Specialisati n, 7 semester): Specialis	on Bioproce on Bioproce	ess Engineerir

Course L0204: Chemica	al Reaction Engineering (Fundamentals)
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)

	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Content	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler- number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, molebalance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
Literature	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH
I	[114]

	Recitation Section (large)
Hrs/wk 2	
CP 2	
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28
Lecturer P	Prof. Raimund Horn, Dr. Oliver Korup
Language D	DE
Cycle V	NiSe
() C C T	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrat (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volu chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, m concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reac reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in station and flowing multicomponent-mixtures)
s s b	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, species, matrix of stoichiometric coefficients, linear dependent and independent reactions, elem species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, rela between stoichiometry and kinetics, calculating the extent of reaction from mole number change complex reactions)
e fi fr t C F	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical read engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in pr first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entr Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, v Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibri calculations in multiple reaction systems, Lagrange Multipliers)
e o fr Content s q ir	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reaction elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, of change of species mole number, Arrhenius-equation, activation energy and pre-exponential fa- for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damkö number, differential and integral method of kinetic analysis, laboratory reactors for kin measurements, half life, kinetics of complex reactions, parallel reactions, reversible reaction sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanis quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analy ntegration of first order differential equations - integrating factor, numerical integration of com kinetics)
d r	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reakt discontinuous, half continuous and continuous reactors, single phase - biphasic- and multipl reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiak staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
ir b fl n s b	sothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reac ntegration of the batch reactor mole balance for various kinetics, partial fraction decomposition, r balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - flow reactor, design of plug flow reactors for reactions with volume change and complex reacti mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuo stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, m balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank react Newton-Raphson method, graphical analysis of a cascade of tank reactors)
r a c p s	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic tempera rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design o adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfe convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor barallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, mul- stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isother reactors, optimum temperature profile of a reactor)
10	ecture notes Raimund Horn
C	skript Frerich Keil
B	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Cher Wiley-VCH

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

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

Courses					
Title Bioprocess Engineering - Ad Bioprocess Engineering - Ad		Typ Lecture Recitation Section (sm	Hrs/wk 2 all) 2	CP 4 2	
Module Responsible	Prof. An-Ping Zeng				
Admission Requirements	None				
Recommended Previous Knowledge		ring I"			
Educational Objectives	After taking part successfully, students h	ave reached the following learn	ing results		
Professional					
Competence					
	After successful completion of this modu	le, students should be able to			
	describe and explain different kine	etic approaches for growth and s	substrate-uptak	e	
Knowledge	 identification of scientific problem and mammalian cells) 	ns with concrete industrial use	(cultivation of	microorganisr	
	 describe and explain important of as basic immobilization methods 	downstreaming steps for protein	ns and their ap	plication as w	
	After successful completion of this modu	le, students should be able to			
	 to identify scientific questions or poss cultivation of microorganisms and anima 			applications (
	- To assess the application of scale-up criteria for different types of bioreactors and processes and to apply these criteria to given problems (anaerobic , aerobic or microaerobically)				
	 to formulate questions for the analysis and optimization of real biotechnological production processe appropriate solutions , 				
Skills	- To describe the effects of the energy g growth inhibition of the behavior of micro				
	- 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 calculat basic types and evaluate them.				
Personal Competence					
Social Competence	After completion of this module particite teams to enhance the ability to take particiteamwork.				
Autonomy	After completion of this module particip their knowledge to previously unknown i		ources of knowl	edge and app	
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56			
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and scale	90 min				
	General Engineering Science (German Compulsory Bioprocess Engineering: Core qualificatic General Engineering Science (English p Compulsory	n: Compulsory			

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

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

Module M1275: E	nvironmental Te	echnology			
Courses					
Title Practical Exercise Environm Environmental Technologie			Typ Practical Course Lecture	Hrs/wk 1 2	CP 1 2
Module Responsible	Prof. Martin Kaltschmit	t			
Admission Requirements	None				
Recommended Previous Knowledge	Fundamentals of inorg	anic/organic chemistry a	nd biology		
Educational Objectives	After taking part succe	ssfully, students have re	ached the following lear	ning results	
Professional Competence					
Knowledge	With the completion of this modul the students obtain profound knowledge of environmenta technology. They are able to describe the behaviour of chemicals in the environment. Students can giv an overview of scientific disciplines involved. They can explain terms and allocate them to relate methods.				
Skills	Students are able to propose appropriate management and mitigation measures for environmenta problems. They are able to determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.				
Personal Competence					
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation.				
Autonomy	Students can independ tranfer it to new proble		out of the subject, acqui	ire the particular	knowledge and
Workload in Hours	Independent Study Tim	ne 48, Study Time in Lec	ture 42		
Credit points	3				
Course achievement	Compulsor₿onus Yes None	Form Subject theoretical practical work	Description and		
Examination	Written exam				
Examination duration and scale	1 hour				
Assignment for the Following Curricula	Engineering: Compulso General Engineering S Elective Compulsory General Engineering Elective Compulsory Bioprocess Engineering Energy and Environme General Engineering S Elective Compulsory General Engineering Engineering: Compulsory General Engineering Elective Compulsory	ory Science (German progra Science (German progr g: Core qualification: Elec ntal Engineering: Core q Science (English progran Science (English progran ory	ualification: Compulsory n, 7 semester): Special n, 7 semester): Specialis am, 7 semester): Speci	lisation Bioproce cialisation Proce lisation Bioproce sation Energy ar	ss Engineering ss Engineering ss Engineering nd Enviromenta

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

nental Technologie
Lecture
2
2
Independent Study Time 32, Study Time in Lecture 28
Prof. Martin Kaltschmitt, Dozenten des SD V
DE
WiSe
 Introductory seminar on environmental science: Environmental impact and adverse effects Wastewater technology Air pollution control Noise protection Waste and recycling management Soil and ground water protection Renewable energies Resource conservation and energy efficiency
Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972- 5 (ISBN)

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
		Reclation Section (Smail)	-	-
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems i	n time and frequency domain, Lapla	ace transform	1
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic particular explain properties of fit They can explain the dynamics or of frequency response and root lot They can explain the Nyquist stal They can explain the role of the particular explain the way a Plaresponse They can explain issues arising implemented digitally 	rst and second order systems f simple control loops and interpret ocus bility criterion and the stability marg ohase margin in analysis and synthe D controller affects a control loop	dynamic pro gins derived f esis of control o in terms o	perties in tern rom it. loops f its frequend
Skills	 Students can transform models vice versa They can simulate and assess the They can design PID controllers v They can analyze and synthesize response techniques They can calculate discrete-time use it for digital implementation They can use standard software tasks 	e behavior of systems and control lo vith the help of heuristic (Ziegler-Nic e simple control loops with the help approximations of controllers desig	oops chols) tuning of root locus gned in conti	rules and frequen nuous-time ar
Personal Competence				
Social Competence	Students can work in small groups to jo	intly solve technical problems, and	experimental	ly validate the
	controller designs Students can obtain information from experiment guides) and use it when sol	n provided sources (lecture note		
Autonomy	They can assess their knowledge in wee	ekly on-line tests and thereby contro	ol their learnii	ng progress.
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German p Bioprocess Engineering: Core qualificati Computer Science: Specialisation Comp Data Science: Core qualification: Electiv Electrical Engineering: Core qualification Energy and Environmental Engineering: General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English	on: Compulsory outational Mathematics: Elective Cor re Compulsory n: Compulsory Core qualification: Compulsory program, 7 semester): Specialisa	npulsory ation Electric alisation Civ	al Engineerin il Engineerin

	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,
Assignment for the	Focus Aircraft Systems Engineering: Compulsory
Following Curricula	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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 0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
-	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	
	 Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability
	 Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants
	 Internal model principle Root locus techniques Root locus plots Root locus design of PID controllers
Content	 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 systemsRoot locus and frequency response of time delay systemsSmith 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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				
Fitle Thermal Separation Process Thermal Separation Process Thermal Separation Process Separation Processes (L115)	es (L0119) es (L0141)	Typ Lecture Recitation Section (small) Recitation Section (large) Practical Course	Hrs/wk 2 2 1 1	CP 2 2 1 1
		Tractical Course	1	T
Module Responsible Admission Requirements				
Requirements	None Recommended requirements: Thermodynar	nics III		
Recommended Previous Knowledge				
ducational Objectives Professional Competence	After taking part successfully, students have	e reached the following learning	results	
Knowledge	 The students can distinguish and or distillation, extraction, and adsorption The students develop an understand process, the estimation of the energy and the selection of separation system They have good knowledge of design 	n Iding for the course of concent Jy demand of a process, the pos ms	ration durir ssibilities of	ig a separat energy savir
Skills	 Using the gained knowledge the stud separation process and can close the The students can use different graph define the amount of theoretical stag They can select and design a basic ty the advantages and disadvantages o The students are capable to obta appropriate sources (diagrams and ta They can calculate continuous and di The students are able to prove their t The students are able to discuss the work with the teachers in colloquium. 	associated energy and material nical methods for the designing of res required ype of thermal separation proces f the process ain independently the needed ables) scontinuous processes theoretical knowledge in the expo theoretical background and the of theoretical background and the of	balances of a separat s for a giver material p erimental la content of th of other lec	ion process a n case based properties fro b work. ne experimen tures and use
Personal Competence				
Social Competence	 The students can work technical assi in the tutorial The students are able to carry out p division of labor between them. The scientifically in a report. 	ractical lab work in small group	s and organ	ize a functio
Autonomy	 The students are capable to obtain the and assess their quality The students can proof the state of this way control their learning process 	their knowledge with exam rese		
Workload in Hours	Independent Study Time 96, Study Time in I	Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration	120 minutes; theoretical questions and calc	ulations		

Assignment for the Following Curricula	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 Energy and Environmental Engineering: Core qualification: 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 General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0118: Thermal	Separation Processes
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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

Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students. 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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 		

ourse L0141: Thermal	Separation Processes
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter d Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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

Тур	Practical Course		
Hrs/wk			
CP			
-	 Independent Study Time 16, Study Time in Lecture 14		
	Prof. Irina Smirnova		
Language			
Cycle			
	 The students work on eight different experiments in this practical course. For every one of the eigexperiments, a colloquium takes place in which the students explain and discuss the theoretic background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, th 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. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separative processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th each McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie 		

Courses Typ Hrs/wk CP Heat and Mass Transfer (L0101) Lacture Section (anay) 1 2 2 Mediated Responsible [Prof. Inita Smirnova Addition Section (anay) 1 2 Mediate Responsible [Prof. Inita Smirnova Addition Section (anay) 1 2 Mediate Responsible [Prof. Inita Smirnova Addition Section (anay) 1 2 Mediate Responsible [Prof. Inita Smirnova Addition Section (anay) 1 2 Recommended Previous Knowledge Basic knowledge: Technical Thermodynamics 1 2 Educational Objectives After taking part successfully, students have reached the following learning quantitative heat transfer mechania reactors. 1 The students are capable of explaining qualitative and determining quantitative heat transfer mechania reactors and thermal relation. 1 The students are capable of distinguish and characterize different kinds of heat transfer mechania reactor and processes in detail. 1 1 1 1 1 1 1 1 1 2 Knowledge The students are able to set reasonable system baundaries for a given transport problem using the gained knowledge and to balance the corresponding neffection. 1 1	Module M0538: H	eat and Mass Transfer			
Heat and Mass Transfer (1010) Lecture 2 2 Medual Mass Transfer (11868) Recitation Section (manual) 2 Medual Responsible Prof. Inina Smirnova 2 Requirements Basic 2 Basic Administion None 2 Provious Knowledge For Inina Smirnova 2 Educational Objectives After taking part successfully, students have reached the following learning results Processional Competence * The students are capable of explaining qualitative and determining quantitative heat transfer mechanisa The students have tability to explain the physical basis for mass transfer in detail and describe mass transfer qualitative and quantitative by using suitable mass transfer theories. * The students are able to set reasonable system boundaries for a given transport problem using the physical basis for mass transfer mechanisa * The students are able to set reasonable system boundaries for a given transport problem using the physical basis for mass transfer theories. * The students are able to set reasonable system boundaries for a given transport problem using the physical basis for mass transfer for a logical physical basis for mass transfer f	Courses				
Module Responsible Prof. Irina Smirnova Admission Requirements None Basic knowledge Basic knowledge: Professional Competence After taking part successfully, students have reached the following learning results Professional Competence The students are capable of explaining qualitative and determining quantitative heat transfer precedual apparatus (e.g. heat excendence, the option the physical basis for mass transfer in detail and describe mass transfer qualitative and quantitative by using suitable mass transfer in detail and describe mass transfer qualitative and quantitative by using suitable mass transfer theories. * The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding neargy and mass fra memphysical basis for a given transport problem using the gained knowledge and to balance the corresponding neargy and mass fra memphysical basis for a given transport problem using the gained knowledge and to balance the corresponding neargy and mass fra memphysical basis for a given transport problem using the gained knowledge and to balance the corresponding neargy and mass fra memphase and to distinguish between diffusion, convective mass transfer and mass transfer mey cause this knowledge for a specific healt transfer problem (e.g., heated chincal recors apparatus. * The students are capable to choose and design fundamental types of heat a mass exchanger for a specific application considering their advantages and disadvantage in advantage of a paperatus. * The students are capable to work on subject-specific challenges in teams and to present to resultsorally in a reasonabl	Heat and Mass Transfer (L01		Lecture	2	2
Admission Requirements None Recommender Previous Knowledge Baic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence • The students are capable of explaining qualitative and determining quantitative heat transfer moternain rocedural apparatus (e.g. heat exchanger, chemical reactors). <i>Knowledge</i> • The students are capable of distinguish and characterize different kinds of heat transfer mechanis morely heat conduction, heat transfer and therma irradiaton. <i>Knowledge</i> • The students are capable of explaining qualitative by using suitable mass transfer theories. • The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding energy and mass for respectively. • The students are able to distinguish between diffusion, convective mass transfer and mass transfer using the gained knowledge for the description and design of apparatus (e.g. extraction colum rectification column). • They are capable to distinguish between diffusion, convective mass transfer and mass transition and mass transition and mass transition concellation considering their advantages and disadvantage paratus. • They are capable to distinguish between diffusion, convective mass transfer indexidon column). • They are capable to using subject-specific challenges in teams and to present in mass exchanger for a specific application considering their advantages and isiadvantage prot	Heat and Mass Transfer (L18	368)	Recitation Section (large)	1	2
Requirements None Recommender Previous Knowledge Baic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g. heat exchanger, chemical reactors). They are capable of distinguish and characterize different kinds of heat transfer methanis namely heat conduction, heat transfer and thermal relation. The students have the ability to explain the physical basis for mass transfer in detail and distribution the transfer and thermal relation. The students are the ability to explain the physical basis for mass transfer in detail and distribution the transfer and thermal relation. The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding energy and mass for respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactor therparatus alteration in fluids) not calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes aparatus.	Module Responsible	Prof. Irina Smirnova			
Recommended Previous Knowledge Basic knowledge Educational Objectives After taking part successfully, students have reached the following learning results Proceedural apparatus (e.g. heat exchanger, chemical reactors). • The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g. heat exchanger, chemical reactors). • The students have the ability to explain the physical basis for mass transfer modelmain Rescribe mass transfer qualitative and quantitative by using sultable mass transfer theories. • The students have the ability to explain the physical basis for mass transfer modelmain secribe mass transfer qualitative and quantitative by using sultable mass transfer theories. • The students are able to set reasonable system boundaries for a given transport problem using the gamed knowledge and to balance the corresponding energy and mass fit (here) are the students are able to set reasonable system boundaries for a given transport problem using the gamed knowledge for the description and design of apparatus (e.g. extraction colur temperature alteration in fluids) and to calculate the corresponding peergy and mass fit (here) are able to distinguish between diffusion, convective mass transfit They are use this knowledge for the description and design fundamental types of heat a sexchanger for a specific application consteady-state processes in procedu apparatus. • The students are capable to owner their knowledge obtained in this course with knowledge of engineering) to solve concrete technical problems. Personal Competence • The students are capable to work on subject-specific challenges in teams and to present t results origit in a reasonable manner		None			
Professional Competence The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e. g. heat exchanger, chemical reactors). They are capable of distinguish and charactrize different kinds of heat transfer mechanis namely heat conduction, heat transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and describe mass transfer qualitative and quantitative by using suitable mass transfer theories. The students are able to depict the analogy between heat- and mass transfer and to describe compliance to depict the analogy between heat- and mass transfer and to describe compliance to the part ability of the analogy between heat- and mass transfer mobilems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes apparatus. They are able to distinguish between diffusion, convective mass transfirmed flows. Using dimensionless quantities, the students can execute scaling up of technical processes apparatus. They are able to distinguish between diffusion, convective mass transfirmed flows. Using dimensionless quantities. In didition, they can calculate both, steady-state and non-steady-state processes in procedurage apparatus. The students are capable to connect their knowledge during their advantages and disadvantage respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedure apparatus. The students are capable to work on subject-specific challenges in teams and to present t results orally	Recommended	Basic knowledge: Technical Thermodynan	nics		
Competence The students are capable of explaining qualitative and determining quantitative heat transfer anomacy heat conduction, heat transfer and thermal radiation. They are capable of distinguish and characterize different kinds of heat transfer mechaniss namely heat conduction, heat transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer theories. They are able to depict the analogy between heat- and mass transfer and to describe compliance the corresponding energy and mass for negepetively. The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding energy and mass for negepetively. They are capable to solve specific heat transfer problems (e.g., heated chemical reacto temperature alteration in fluids) and to calculate the corresponding energy and mass for heappartus. Using dimensionless quantities, the students can execute scaling up of technical processes apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer and to balance the corresponding heat fluids. They are able to distinguish between diffusion considering of apparatus (e.g. extraction colum net this knowledge for the description and design fundamental types of heat a mass exchanger for a specific application considering their advantages and disadvantage respectively. The students are capable to connect their knowledge obtained in this course with knowledge anguering) to solve concrete technical problems. Personal Competence The students are capable to work on subject-specific challenges in teams and to present t results orally in a rea	Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Proceedural apparatus (e. g. heat exchanger, chemical reactors). Iney are capable of distinguish and characterize different kinds of heat transfer mechanis namely heat conduction, heat transfer and thermal radiation. Knowledge Knowledge Iney are capable of distinguish and characterize different kinds of heat transfer mechanis namely heat conduction, heat transfer and thermal radiation. Iney are capable of distinguish and characterize different kinds of heat transfer mechanis for a given transport problem using the gained knowledge and to balance the corresponding nergy and mass flor respectively. Iney are capable to solve specific heat transfer problems (e.g. heated chemical reactors). Using dimensionless quantities, the students can execute scaling up of technical processes in apparatus. Iney are capable to distinguish between diffusion, convective mass transfion and mass transfer They can use this knowledge for the description and design of apparatus (e.g. extraction colum rectification colum). In this context, the students are capable to conset and design fundamental types of heat apparatus. In addition, they can calculate both, steady-state and non-steady-state processes in proceed other courses (in particular the course thermodynamics, fluid mechanics and chemical procese engineering) to solve concret technical problems. Personal Competence The students are capable to work on subject-specific challenges in teams and to present t results orally in a reasonable manner to tutors and other students. The students are capable to find and evaluate necessary informa					
wing the gained knowledge and to balance the corresponding energy and mass flor respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes apparatus. They are able to distinguish between diffusion, convective mass transition and mass transf They can use this knowledge for the description and design of apparatus (e.g. extraction colum rectification column). In this context, the students are capable to choose and design fundamental types of heat a mass exchanger for a specific application considering their advantages and disadvantage respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedu apparatus. The students are capable to connect their knowledge obtained in this course with knowledge other courses (In particular the courses thermodynamics, fluid mechanics and chemical proceengineering) to solve concrete technical problems. Personal Competence The students are capable to work on subject-specific challenges in teams and to present t results orally in a reasonable manner to tutors and other students. The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedu continuously (clicker-system, exam-like assignments) and on this basis they can control th learning processes. Workload in Hours Independent Study Time 124, Study	Knowledge	 procedural apparatus (e. g. heat ex They are capable of distinguish a namely heat conduction, heat trans The students have the ability to describe mass transfer qualitative a They are able to depict the analog 	cchanger, chemical reactors). nd characterize different kinds of sfer and thermal radiation. explain the physical basis for ma and quantitative by using suitable	heat trans ss transfer mass transf	fer mechanisr in detail and er theories.
Social Competence The students are capable to work on subject-specific challenges in teams and to present to results orally in a reasonable manner to tutors and other students. The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedu continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Mone Examination duration Written exam I20 minutes: theoretical guestions and calculations I20 minutes: theoretical guestions and calculations 	Skills	 using the gained knowledge an respectively. They are capable to solve specitiemperature alteration in fluids) and Using dimensionless quantities, the apparatus. They are able to distinguish betwork They can use this knowledge for the rectification column). In this context, the students are comass exchanger for a specific all respectively. In addition, they can calculate bot apparatus. The students are capable to connect other courses (In particular the construction of the course). 	id to balance the corresponding fic heat transfer problems (e.g. ad to calculate the corresponding h he students can execute scaling u een diffusion, convective mass tra- te description and design of appara capable to choose and design func- pplication considering their advan- th, steady-state and non-steady-sta- ect their knowledge obtained in thi- urses thermodynamics, fluid mech	g energy a heated che eat flows. p of technic ansition and tus (e.g. ext damental typ ntages and ate processo s course wi	nd mass flo emical reactor al processes mass transfe craction colum pes of heat ar disadvantage es in procedur th knowlegde
Social Competence results orally in a reasonable manner to tutors and other students. Autonomy • The students are able to find and evaluate necessary information from suitable sources Autonomy • They are able to prove their level of knowledge during the course with accompanying proceduc continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Course achievement None Examination duration Written exam I20 minutes: theoretical questions and calculations	Personal Competence				
Autonomy They are able to prove their level of knowledge during the course with accompanying procedul continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Course achievement None Examination duration Independent study Time and calculations 	Social Competence	recults orally in a reasonable mann		teams and	to present tl
Credit points 6 Course achievement None Examination Written exam Examination duration 120 minutes: theoretical questions and calculations	Autonomy	 They are able to prove their level of continuously (clicker-system, exan 	of knowledge during the course wil	th accompai	nying procedu
Course achievement None Examination Written exam Examination duration 120 minutes: theoretical questions and calculations	Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Examination Written exam Examination duration	Credit points	6			
Examination duration	Course achievement	None			
LZU MINUTES: TREOFETICAL QUESTIONS AND CAICULATIONS	Examination	Written exam			
	Examination duration and scale	120 minutes; theoretical questions and ca	alculations		

	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 Energy and Enviromental
	Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess 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
	Technomathematics: Specialisation III. Engineering Science: 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	 Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions 		
Literature	 H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas 		

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

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

Module M0670: P	article Technol	ogy and Solid	s Process Engineerii	ng	
Courses					
Title			Тур	Hrs/wk	СР
Particle Technology I (L0434 Particle Technology I (L0435			Lecture Recitation Section (sm	2 Iall) 1	3 1
Particle Technology I (L043)			Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements					
Recommended Previous Knowledge	reine				
Educational Objectives	After taking part succ	essfully, students ha	ve reached the following learr	ning results	
Professional Competence					
	After successful comp	letion of the module	students are able to		
Knowledge			nit-operations of solids proces butions and to discuss their b		
Skills	 Students are able to choose and design apparatuses and processes for solids processing according to the desired solids properties of the product asses solids with respect to their behavior in solids processing steps document their work scientifically. 				
Personal Competence					
Social Competence	The students are able develop solutions for t		topics orally with other stude sues in a group.	nts or scientific	personal and
Autonomy	Students are able to a	inalyze and solve qu	estions regarding solid particle	es independentl	/.
Workload in Hours	Independent Study Ti	me 110, Study Time	in Lecture 70		
Credit points					
-	Compulsor₿onus	Form	Description		
Course achievement	Yes None	Written elaboratio	n sechs Berichte (pr Seiten	o Versuch ein I	Bericht) à 5-1
Examination	Written exam				
Examination duration and scale					
Assignment for the Following Curricula	Compulsory General Engineering Compulsory General Engineering Engineering: Compuls Bioprocess Engineerin Energy and Environme General Engineering Compulsory General Engineering Engineering: Compuls	Science (German pr Science (German pr ory Ig: Core qualification ental Engineering: Co Science (English pro Science (English pro ory Science (English pro	ore qualification: Compulsory ogram, 7 semester): Speciali gram, 7 semester): Specialis orogram, 7 semester): Spec	isation Bioproce sation Energy ar sation Bioproce ation Energy ar	ss Engineerin nd Enviroment ss Engineerin nd Enviroment

Course L0434: Particle	Technology I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport
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		
Recitation Section (small)		
1		
1		
Independent Study Time 16, Study Time in Lecture 14		
Prof. Stefan Heinrich		
DE		
SoSe		
See interlocking course		
See interlocking course		

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

Courses					
Fitle Management Tutorial (L088 ntroduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3	
Module Responsible	Prof. Christoph Ihl				
Admission	Nono				
Requirements	None				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business	Basic Knowledge of Mathematics and Business			
ducational Objectives	After taking part successfully, students have re	ached the following learning	results		
Professional Competence					
Knowledge	 After taking this module, students know the in Management, from Planning and Organisation Controlling. In particular they are able to explain the differences between Ecc Management and to name important de explain the most important aspects of aspects of entreprneurial projects describe and explain basic business fur chain management, organization and hi innovation management and marketing explain the relevance of planning and multiple objectives and uncertainty, Finance state basics from accounting and costin 	to Marketing and Innovation, nomics and Management a finitions from the field of Man and goals in Management and ctions as production, procure uman ressource management decision making in Busines and explain some basic me g and selected controlling me	and also to l and the sul agement d name the ement and s , information s, esp. in s ethods from thods.	Investment an b-disciplines i most importar ourcing, suppl n managemen ituations unde mathematica	
Skills	 Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 				
Personal Competence					
•••••	Students are able to				
Social Competence	 work successfully in a team of students to apply their knowledge from the lect report on the project to communicate appropriately and to cooperate respectfully with their fello 		roject and w	rrite a coherer	
	Students are able to				
Autonomy	 work in a team and to organize the team to write a report on their project. 	a themselves			
Workload in User	Independent Study Time 110 Study Time in L	cture 70			
Credit points	Independent Study Time 110, Study Time in Le				
Course achievement					
	Subject theoretical and practical work				
Examination duration					
	General Engineering Science (German program Civil- and Environmental Engineering: Core qua Civil- and Environmental Engineering: Specialis Civil- and Environmental Engineering: Specialis Civil- and Environmental Engineering: Specialis Bioprocess Engineering: Core qualification: Con Computer Science: Core qualification: Compulse Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Com Energy and Environmental Engineering: Core of	Ilification: Compulsory ation Civil Engineering: Electi ation Water and Environment ation Traffic and Mobility: Ele npulsory ory pulsory	ve Compulso :: Elective Co	ory ompulsory	

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
Compulsory
General Engineering Science (English program, 7 semester); Specialisation Bioprocess Engineering;
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Biomechanics: Compulsory
Assignment for the General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula 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 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 Naval Architecture
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering
Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Core gualification: Compulsory
Mechanical Engineering: Core gualification: Compulsory
Mechatronics: Core gualification: Compulsory
Orientierungsstudium: Core qualification: Elective Compulsory
Naval Architecture: Core gualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory

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

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

		nt Engineering			
Courses					
Title			Тур	Hrs/wk	СР
Process and Plant Engineeri Process and Plant Engineeri	-		Lecture Recitation Section (large	2) 1	2 2
Process and Plant Engineeri	•		Recitation Section (small		2
Module Responsible	Prof. Mirko Skiborowsk	xi			
Admission Requirements	None				
Recommended	unit operation of thern	nal an dmechanical se	paration processes		
Previous Knowledge	chemical reactor eingi	neering			
Educational Objectives	After taking part succe	essfully, students have	e reached the following learnin	g results	
Professional					
Competence	students can:				
		blobal balanco oquat	ons of chemical processes		
	-				
Knowledge			lex chemical processes		
	explain linear regression and data reconcilliation problems				
	explain pfd-diagrams				
	students are capable of				
	- formulation of mass and energy balance equations and estimation of product streams				
	- estimation of component streams of chemical plants using linear component balance models				
Skills	- solution of data reconcilliation tasks				
	- conduction of process synthesis				
	- economic evaluation of processes and the estimation of production costs				
	- economic evaluation	or processes and the	estimation of production costs		
Personal Competence					
Social Competence					
Autonomy Workload in Hours	Independent Study Tir	ne 124 Study Time in	Lecture 56		
Credit points		ne 124, Study Time in			
-	CompulsorBonus	Form	Description		
Course achievement	Yes 10 %	Subject theoretic practical work	al and		
	Written exam				
Examination duration and scale	120 Min. lectures note	s and books			
		Science (German pr	ogram, 7 semester): Special	isation Proce	ss Engineerir
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering				
	Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta Engineering: Elective Compulsory				
	Bioprocess Engineering: Core qualification: Compulsory				
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental				
	Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering				
	Compulsory				
	Process Engineering: C	Core qualification: Con	npulsory		

Course L0095: Process and Plant Engineering I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mirko Skiborowski	

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

Course L1214: Process and Plant Engineering I		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Mirko Skiborowski, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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Courses				
Fitle Environmental Assessment	(1.0860)	Typ Lecture	Hrs/wk 2	CP 2
Environmental Assessment		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Requirements	Fundamentals of inorganic/organic	chemistry and biology		
Previous Knowledge				
	After taking part successfully, stuc	lents have reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competent is dealing with different methods and instruments to assess environmental impacts. Besides the student are able to estimate the complexity of these environmental processes as well as uncertainties an 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 mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts.			
Personal Competence				
	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 of th future social responsibilities in their role as engineers.			
	The students learn to research, process and present a scientific topic independently. They are able carry out independent scientific work. They can solve an environmental problem in a business conter and are able to judge results of other publications.			
Workload in Hours	Independent Study Time 48, Study	Time in Lecture 42		
Credit points				
Course achievement				
Examination				
Examination duration and scale	1 hour written exam			
and scale		man program, 7 semester): Specialisatio	n Energy ar	nd Enviromer
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromen Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineerin Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromen Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromen Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromen Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineerin Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineerin Elective Compulsory Process Engineering: Core qualification: Elective Compulsory			

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

Course L1054: Environ	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 Circuit Theory (L0566) Circuit Theory (L0567)		Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 4 2	
Module Responsible	Prof. Arne lacob				
Admission Requirements					
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and II	I			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results		
Professional Competence					
Knowledge	Students are able to explain the basic methods for calculating electrical circuits. They know the Fourie series analysis of linear networks driven by periodic signals. They know the methods for transien analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits.				
Skills	The students are able to calculate currents and voltages in linear networks by means of basic method also when driven by periodic signals. They are able to calculate transients in electrical circuits in tim 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	Students work on exercise tasks in small guided their results within the group.	groups. They are encoura	ged to pres	ent and discus	
Social Competence					
Autonomy	The students are able to find out the required methods for solving the given practice problem 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		re 70			
Credit points					
Course achievement					
	Written exam				
Examination duration and scale	150 min				
	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
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	Focus Mechatronics: Compulsory
3 • • • •	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective
	Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Mechatronics: Core qualification: Compulsory
I	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

ourse L0566: Circuit Theory					
Тур	Lecture				
Hrs/wk	3				
СР	4				
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42				
Lecturer	Prof. Arne Jacob				
Language	DE				
Cycle	WiSe				
	- Circuit theorems				
	- N-port circuits				
	- Periodic excitation of linear circuits				
Content	- Transient analysis in time domain				
	- Transient analysis in frequency domain; Laplace Transform				
	- Frequency behaviour of passive one-ports				
	- M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011)				
	- M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011)				
	- L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011)				
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)				
Literature	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008) - R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006)				
	- L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)				

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

Courses					
Title			Tun	Hrs/wk	СР
Computer Engineering (L03	21)		Typ Lecture	пі 5/ w к З	4
Computer Engineering (L03	24)		Recitation Section (small)	1	2
Module Responsible					
Admission Requirements	None				
•	Basic knowledge in ele	ectrical engineering			
Previous Knowledge					
		essfully, students have	e reached the following learning	results	
Professional Competence					
Knowledge	Iechnological foundations				
	 Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinin Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poi connections, busses 				
	internal structure and highly specific and in components. They are	the physical composed of the physical computers able to distinguish	from the architect's perspectition of computer systems. The can be built based on a cobetween and to explain the didicircuits up to complete process	e students ca llection of fe fferent abstra	n analyze, ho ew and simp
Skills	After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they sl understand the consequences that the execution of software has on the hardware-centric abstract layers from the assembly language down to gates. This way, they will be enabled to evaluate impact that these low abstraction levels have on an entire system's performance and to prop- feasible options.				
Personal Competence					
Social Competence	e Students are able to solve similar problems alone or in a group and to present the results accordingly				
	Students are able to acquire new knowledge from specific literature and to associate this knowled with other classes.				
Workload in Hours	Independent Study Tin	ne 124, Study Time in	Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus Yes 10 %	Form Excercises	Description		
Examination		Excercises			
Examination duration and scale		f			
and scale	90 minutes, contents o	of course and labs			
	General Engineering Compulsory	Science (German p	rogram, 7 semester): Specia	lisation Com	puter Scienc
	General Engineering S	Science (German pro	gram, 7 semester): Specialisat	ion Bioproce	ss Engineerin
	Compulsory General Engineering	Science (German p	rogram, 7 semester): Specia	lisation Nava	al Architectur
	Compulsory		program, 7 semester): Speci		
	Compulsory		.		5
	General Engineering Compulsory	Science (German pro	ogram, 7 semester): Specialisa	ation Electric	al Engineerin
		Science (German pro	gram, 7 semester): Specialisat	ion Biomedic	al Engineerin
	General Engineering S		ram, 7 semester): Specialisatio	on Energy an	d Enviroment
	5 5		ogram, 7 semester): Specialis	sation Proces	s Engineerin
	Compulsory General Engineering S	Science (German pro	gram, 7 semester): Specialisat	ion Mechanic	al Engineerin
	Focus Mechatronics: C	ompulsony			

	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Aircraft Systems Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Materials in Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Product Development and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Energy Systems: Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Electrical Engineering: 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
G	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering;
	Compulsory
G	Seneral Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	ngineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Mechatronics: Compulsory Seneral 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,
	ocus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Aechatronics: Core qualification: Compulsory
Т	echnomathematics: Specialisation II. Informatics: Elective Compulsory

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

Course L0324: Compute	urse 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
Signals and Systems (L0432		Lecture	3	4
Signals and Systems (L0433)	Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
Decommonded	The modulic an introduction to the theory of sign	ale and systems. Cood kno	wladaa in m	athe ac cava
Previous Knowledge	The modul is an introduction to the theory of sign by the moduls Mathematik 1-3 is expected. Furtl series, Fourier transform, Laplace transform) is us	her experience with spect		
ducational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence	The shade to see the second state of the second state of the	Structure and the constitute for		
Knowledge	The students are able to classify and describe a methods of signal and system theory. They are continuous-time and discrete-time signals and sy signals and systems mathematically in both time effects in time domain and image domain whic signal to a discrete-time signal.	e able to apply the funda ystems. They can describe and image domain. In part	amental trans and analys ticular, they	nsformations se determinis understand t
Skills	The students are able to describe and analyse d using methods of signal and system theory. The important properties such as magnitude and pha the impact of LTI systems on the signal properties	ey can analyse and desig ase response, stability, line	n basic syst earity etc T	tems regardi
Personal Competence				
	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant inforr control their level of knowledge during the lectur clicker system.			
	Independent Study Time 110, Study Time in Lectu	ure 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program	, 7 semester): Specialisa	tion Electric	al Engineerir
	Compulsory General Engineering Science (German program	m 7 comostor), Spaciali	ication Com	nutor Scion
	Compulsory	m, / semester): Special	Isation Con	iputer Scien
	General Engineering Science (German program	n, 7 semester): Specialis	ation Proce	ss Engineerir
	Compulsory General Engineering Science (German program,	7 semester): Specialisation	on Bioproce	ss Engineerir
	Compulsory			5
	General Engineering Science (German program, Compulsory	7 semester): Specialisation	on Biomedio	cal Engineerir
	General Engineering Science (German program,	/ semester): Specialisatio	on Mechanic	al Engineerir
	Focus Biomechanics: Compulsory			5
	Focus Biomechanics: Compulsory General Engineering Science (German program,			5
	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program,	7 semester): Specialisatio	on Mechanic	cal Engineerir
	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory	7 semester): Specialisatio 7 semester): Specialisatio	on Mechanic on Mechanic	cal Engineerir
	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program,	7 semester): Specialisatio7 semester): Specialisatio7 semester): Specialisatio	on Mechanic on Mechanic	cal Engineerir
	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program,	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio sory	on Mechanic on Mechanic on Mechanic	cal Engineerir cal Engineerir cal Engineerir
	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compu	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio ulsory	on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compu Computer Science: Core qualification: Compulsory Electrical Engineering: Core gualification: Compulsory	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio	on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compu Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compul General Engineering Science (English program,	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio	on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compu Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, Compulsory	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio ulsory y sory , 7 semester): Specialisatio	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compul Computer Science: Core qualification: Compulsory Electrical Engineering Science (English program, Compulsory General Engineering Science (English program Compulsory	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio y sory , 7 semester): Specialisatio m, 7 semester): Specialisation	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic tion Electric sation Com	cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering Science (English program, Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio y sory , 7 semester): Specialisatio m, 7 semester): Specialisation	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic tion Electric sation Com	cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compul Computer Science: Core qualification: Compulsory Electrical Engineering Science (English program, Compulsory General Engineering Science (English program Compulsory	7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio ory 7 semester): Specialisatio 7 semester): Specialisatio sory 5 ory 7 semester): Specialisatio m, 7 semester): Specialisation n, 7 semester): Specialisation	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic tion Electric sation Com ation Proces	cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir

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

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

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

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Courses						
Title Electrotechnical Experiment Materials in Electrical Engine		Typ Lecture Lecture	Hrs/wk 1 2	CP 1 3		
•	eering (Problem Solving Course) (L0687)	Recitation Section (small)	2	2		
Module Responsible	Prof. Manfred Eich					
Admission Requirements	None	None				
Recommended Previous Knowledge	Highschool level physics and mathematics					
Educational Objectives	After taking part successfully, students have	e reached the following learning	results			
Professional Competence						
Knowledge	Students can explain the composition and the structural properties of materials used in electrical engineering. Students can explicate the relevance of mechanical, electrical, thermal, 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 derive approximative solutions and judge factors influential on the performance of materials in electrica engineering applications.					
Personal Competence Social Competence	Students can jointly solve subject related problems in groups. They can present their results effective within the framework of the problem solving course.					
Autonomy	Students are capable to extract relevant information from the provided references and to relate th information to the content of the lecture. They can reflect their acquired level of expertise with the hel of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures.					
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70				
Credit points	6					
Course achievement	None					
Examination						
Examination duration and scale	60 minutes					
Assignment for the Following Curricula	General Engineering Science (German pro Compulsory Electrical Engineering: Core qualification: Co General Engineering Science (English pro Compulsory Computational Science and Engineering: Sp Orientierungsstudium: Core qualification: Ele	ompulsory gram, 7 semester): Specialisa ecialisation Engineering Science	tion Electric	al Engineerin		

urse L0714: Electrotechnical Experiments Typ Lecture		
Hrs/wk 1		
Hrs/wk CP		
	Independent Study Time 16, Study Time in Lecture 14	
	Dr. Wieland Hingst	
Language		
Cycle		
-	Agenda:	
	- Natural sources of electricity	
	- Oscilloscope	
	- Characterizing signals	
	- 2 terminal circuit elements	
	- 2-ports	
	- Power	
	- Matching	
Content	- Inductive coupling	
	- Resonance	
	- Radio frequencies	
	- Transistor circuits	
	- Electrical measurement	
	- Materials for the EE	
	- Electrical fun	
	Tietze, Schenk: "Halbleiterschaltungstechnik", Springer	
Literature		

Тур	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	
Content	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition. Symmetries, conserved quantities, and the labeling of states. Angular momentum The hydrogen atom Waves in periodic potentials Reciprocal lattice and reciprocal lattice vectors Band gap Band diagrams The free electron gas and the density of states Fermi-Dirac distribution Density of charge carriers in semiconductors Conductivity in semiconductors. Engineering conductivity through doping. The P-N junction (diode) Light emitting diodes Electromagnetic waves interacting with materials Reflection and refraction Photonic band gaps Origins of magnetization Hysteresis in ferromagnetic materials Magnetic domains
Literature	 Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials Massachusetts Institute of Technology (MIT), 2013 Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004 Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994 Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994 Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979 Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004 Ashcroft, Mermin, Solid State Physics, Harcourt, 1976 Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988 Sze, Physics of Semiconductor Devices, Wiley, 1981 Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007 Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 2003 Handley, Modern Magnetic Materials, Wiley, 2000

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

Courses				
litle		Тур	Hrs/wk	СР
	tial Differential Equations) (L1043)	Lecture	2	1
	tial 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 1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended	Mathematics 1 - III			
Previous Knowledge				
	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence				
Knowledge	 Students can name the basic concepts in Mathematics IV. They are able to explain them usin appropriate examples. Students can discuss logical connections between these concepts. They are capable illustrating these connections with the help of examples. They know proof strategies and can reproduce them. 			
Skills	 Students can model problems in Mathematics IV with the help of the concepts studied in th course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concept studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able critically evaluate the results. 			
Personal Competence	• Students are able to work together is		na ath ann ati	
Social Competence	 Students are able to work together in language. In doing so, they can communicate partners. Moreover, they can design peers. 	new concepts according to the	needs of th	eir cooperati
Autonomy	 Students are capable of checking the can specify open questions precisely Students have developed sufficient oriented manner on hard problems. 	and know where to get help in so	olving them.	
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	erential Equations 2)		
	General Engineering Science (German pr Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering: General Engineering Science (German p Compulsory Computer Science: Specialisation Computat Electrical Engineering: Core qualification: C General Engineering Science (English pro	gram, 7 semester): Specialisatic gram, 7 semester): Specialisatic Compulsory program, 7 semester): Speciali tional Mathematics: Elective Com ompulsory	on Mechanic on Mechanic sation Nava pulsory	cal Engineerin cal Engineerin al Architectur

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

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

Course L1044: Differen	ourse 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		
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	Main features of complex analysis • Functions of one complex variable • Complex differentiation • Conformal mappings • Complex integration • Cauchy's integral theorem • Cauchy's integral theorem • Cauchy's integral formula • Taylor and Laurent series expansion • Singularities and residuals • Integral transformations: Fourier and Laplace transformation	
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 	

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

Course L1042: Complex	ourse 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	

Courses				
	eers I: Time-Independent Fields (L2281) eers I: Time-Independent Fields (L2282)	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 5 1
	Prof. Christian Schuster			
Admission Requirements	None			
Recommended Previous Knowledge	Basic principles of electrical engineering ar	d advanced mathematics		
Educational Objectives	After taking part successfully, students hav	e 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 independent, electromagnetic field proble methods that require solving Maxwell's Equ the principal effects of given time-independ can deduce meaningful quantities for the c flow fields (capacitances, inductances, re practical applications.	ms. Furthermore, they are capab uations for more general problem dent sources of fields and analyze haracterization of electrostatic, m	le of applyi s. The stude these quar agnetostati	ng a variety o ents can asses ntitatively. They c, and electrica
Personal Competence				
	Students are able to work together on sub their results effectively (e.g. during exercis		s. They are	able to presen
Autonomy	Students are capable to gather necessinformation to the lecture. They are able that accompany the lecture, such as shorelated to the exam. Based on respective learning process. They are able to draw co and the content of other lectures (e.g. Elect	to continually reflect their knowle rt oral quizzes during the lectu feedback, students are expecte onnections between their knowled	edge by mea res and exe d to adjust dge obtaine	ans of activitie ercises that are their individua d in this lecture
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (English pr	ogram, 7 semester): Specialisat	ion Electric	al Engineering

Typ Lecture Hrs/wk 3 CP 5 Workload in Hours Independent Study Time 108, Study Time in Lecture 42 Lecturer Prof. Christian Schuster, Dr. Cheng Yang Language EN Cycle SoSe - - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs. - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)	ourse L2281: Electrom	nagnetics for Engineers I: Time-Independent Fields
CP 5 Workload in Hours Independent Study Time 108, Study Time in Lecture 42 Lecturer Prof. Christian Schuster, Dr. Cheng Yang Language EN Cycle SoSe - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation Content - Fields of electrical current density and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs.	Тур	Lecture
Workload in Hours Independent Study Time 108, Study Time in Lecture 42 Lecturer Prof. Christian Schuster, Dr. Cheng Yang Language EN Cycle SoSe - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation - Electrostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems - The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs.	Hrs/wk	3
Lecturer Prof. Christian Schuster, Dr. Cheng Yang Language EN Cycle SoSe - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation Content - Electrostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs.	СР	5
Language EN Cycle SoSe - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation Content - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs.		
Cycle SoSe - Maxwell's Equations in integral and differential notation - Boundary conditions - Laws of conservation for energy and charge - Classification of electromagnetic field properties - Integral characteristics of time-independent fields (R, L, C) - Generic approaches to solving Poisson's Equation Content - Electrostatic fields and specific methods of solving - Magnetostatic fields and specific methods of solving - Fields of electrical current density and specific methods of solving - Action of force within time-independent fields - Numerical methods for solving time-independent problems The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs.		
 Maxwell's Equations in integral and differential notation Boundary conditions Laws of conservation for energy and charge Classification of electromagnetic field properties Integral characteristics of time-independent fields (R, L, C) Generic approaches to solving Poisson's Equation Content Electrostatic fields and specific methods of solving Magnetostatic fields and specific methods of solving Fields of electrical current density and specific methods of solving Action of force within time-independent fields Numerical methods for solving time-independent problems The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs. 		
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 Magnetostatic fields and specific methods of solving Fields of electrical current density and specific methods of solving Action of force within time-independent fields Numerical methods for solving time-independent problems The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs. 		- Generic approaches to solving Poisson's Equation
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The practical application of numerical methods will be trained within specifically prepared lecture an interactive manner using small MATLAB programs.		- Action of force within time-independent fields
an interactive manner using small MATLAB programs.		- Numerical methods for solving time-independent problems
- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)		The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner using small MATLAB programs.
		- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)
- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)		- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)
- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)		- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)
Literature - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)	Literature	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)		- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)		- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

ourse L2282: Electromagnetics for Engineers I: Time-Independent Fields	
Recitation Section (small)	
2	
1	
Independent Study Time 2, Study Time in Lecture 28	
Prof. Christian Schuster, Dr. Cheng Yang	
EN	
SoSe	
See interlocking course	
See interlocking course	

Compatibility	
Courses	
Title	Typ Hrs/wk CP
	Antennas, and Electromagnetic Compatibility (L1669)Lecture34Antennas, and Electromagnetic Compatibility (L1877)Recitation Section (small)22
Module Responsible	Prof. Christian Schuster
Admission Requirements	None
Becommended	Basic principles of physics and electrical engineering
-	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	 Students can explain the basic principles, relationships, and methods for the design of waveguides and antennas as well as of Electromagnetic Compatibility. Specific topics are: Fundamental properties and phenomena of electrical circuits Steady-state sinusoidal analysis of electrical circuits Fundamental properties and phenomena of electromagnetic fields and waves Steady-state sinusoidal description of electromagnetic fields and waves Useful microwave network parameters Transmission lines and basic results from transmission line theory Plane wave propagation, superposition, reflection and refraction General theory of waveguides Most important types of waveguides and their properties Radiation and basic antenna parameters Most important types of antennas and their properties Numerical techniques and CAD tools for waveguide and antenna design Fundamentals of Electromagnetic Compatibility Coupling mechanisms and countermeasures Shielding, grounding, filtering Standards and regulations EMC measurement techniques
<i>Skills</i> Personal Competence	Students know how to apply various methods and models for characterization and choice of waveguides and antennas. They are able to assess and qualify their basic electromagnetic properties. They can apply results and strategies from the field of Electromagnetic Compatibility to the development of electrical components and systems.
Social Competence	Students are able to work together on subject related tasks in small groups. They are able to presentheir results effectively in English (e.g. during small group exercises).
Autonomy	Students are capable to gather information from subject related, professional publications and relat that information to the context of the lecture. They are able to make a connection between their knowledge obtained in this lecture with the content of other lectures (e.g. theory of electromagneti fields, fundamentals of electrical engineering / physics). They can discuss technical problems and physical effects in English.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	
Course achievement	
Examination	
Examination duration and scale	45 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Electrice Compulsory Electrical Engineering: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Air Transportation Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory Aircraft Systems Engineering: Specialisation Cabin Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory

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Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	DE/EN
Cycle	
	This course is intended as an introduction to the topics of wave propagation, guiding, sending, a receiving as well as Electromagnetic Compatibility (EMC). It will be useful for engineers that face technical challenge of transmitting high frequency / high bandwidth data in e.g. medical, automoti or avionic applications. Both circuit and field concepts of wave propagation and Electromagnet Compatibility will be introduced and discussed. Topics: - Fundamental properties and phenomena of electrical circuits - Steady-state sinusoidal analysis of electrical circuits
Content	 Fundamental properties and phenomena of electromagnetic fields and waves Steady-state sinusoidal description of electromagnetic fields and waves Useful microwave network parameters Transmission lines and basic results from transmission line theory Plane wave propagation, superposition, reflection and refraction General theory of waveguides Most important types of waveguides and their properties Radiation and basic antenna parameters Most important types of antennas and their properties Numerical techniques and CAD tools for waveguide and antenna design Fundamentals of Electromagnetic Compatibility Coupling mechanisms and countermeasures Shielding, grounding, filtering Standards and regulations EMC measurement techniques
	- Zinke, Brunswig, "Hochfrequenztechnik 1", Springer (1999) - J. Detlefsen, U. Siart, "Grundlagen der Hochfrequenztechnik", Oldenbourg (2012)
Literature	- D. M. Pozar, "Microwave Engineering", Wiley (2011)
	- Y. Huang, K. Boyle, "Antenna: From Theory to Practice", Wiley (2008)
	- H. Ott, "Electromagnetic Compatibility Engineering", Wiley (2009)
	- A. Schwab, W. Kürner, "Elektromagnetische Verträglichkeit", Springer (2007)

Course L1877: Introduc	Course L1877: Introduction to Waveguides, Antennas, and Electromagnetic Compatibility	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Christian Schuster	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0675: Ir	ntroduction to Communication	s and Random Proces	ses				
Courses							
Introduction to Communicat	tions and Random Processes (L0442) tions and Random Processes (L0443) tions and Random Processes (L2354)	Typ Lecture Recitation Section (large) Recitation Section (small)	Hrs/wk 3 1 1	CP 4 1 1			
Module Responsible							
Admission Requirements	None						
Recommended Previous Knowledge							
Educational Objectives	After taking part successfully, students have	e reached the following learning	results				
Professional Competence							
Knowledge	The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic communications system.						
Skills	The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method.						
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 110, Study Time in Lecture 70						
Credit points	6						
Course achievement	None						
	Written exam						
Examination duration and scale	90 min						
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory						

Тур	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	WiSe
Content	 Fundamentals of random processes Introduction to communications engineering Quadrature amplitude modulation Description of radio frequency transmission in the equivalent complex baseband Transmission channels, channel models Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM) Fundamentals of information theory, source coding, channel coding Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyque condition, matched filter, detection, error probability
Literature	 Fundamentals of digital modulation 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: Introduc	Course L0443: Introduction to Communications and Random Processes	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Courses				
	Introduction to Electrical Power Systems (L1670) Introduction to Electrical Power Systems (L1671)	Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Electrical Engineering			
Educational Objectives	After taking part successfully, students have read	ached the following learning	results	
Professional Competence				
Knowledge	Students are able to give an overview of conventional and modern electric power systems. They cate 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 ar represent their own work results in front of others.			
Autonomy	Students can independently tap knowledge of the emphasis of the lectures.			
Workload in Hours	Independent Study Time 110, Study Time in Leo	cture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 - 150 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineeri Elective Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory Energy Systems: Specialisation Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineeri Elective Compulsory Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elect Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory			

Тур	Lecture
Hrs/wk	
CP	
	Prof. Christian Becker
Language	
Cycle	 fundamentals and current development trends in electric power engineering tasks and history of electric power systems symmetric three-phase systems fundamentals and modelling of eletric power systems lines transformers synchronous machines loads and compensation grid structures and substations fundamentals of energy conversion electro-mechanical energy conversion thermodynamics power station technology renewable energy conversion systems steady-state network calculation (n-1)-criterion symmetric failure calculations, short-circuit power control in networks and power stations grid planning power economy fundamentals
Literature	 K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflag 2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017 R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Module M0783: M	leasurements:	Methods ar	nd Data P	rocessing		
Courses						
Title				Тур	Hrs/wk	СР
EE Experimental Lab (L0781	L)			Practical Course	2	2
Measurements: Methods an	d Data Processing (L0779	9)		Lecture	2	3
Measurements: Methods an	d Data Processing (L0780))		Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlae	efer				
Admission Requirements	None					
Recommended Previous Knowledge	principles of mathema principles of electrical	tics engineering				
Educational Objectives	After taking part succe	essfully, students	s have reache	d the following learning	results	
Professional						
Competence						
Knowledge	measurements. They	can detail aspec	ts of probabil	metrology and the acc ity theory and errors, an lize and describe measu	nd explain th	
Skills	The students are able processing of measure		roblems of m	etrology and to apply r	nethods for	describing and
Personal Competence						
Social Competence	The students solve pro	blems in small g	groups.			
Social competence						
Autonomy	The students can refle	ct their knowled	lge and discus	s and evaluate their res	ults.	
Workload in Hours	Independent Study Tir	ne 110, Study Ti	ime in Lecture	e 70		
Credit points						
Course achievement	CompulsorBonus Yes 10 %	Form Excercises		Description		
Examination		Excercises				
	Written exam					
Examination duration and scale	90 min					
Assignment for the Following Curricula	Elective Compulsory Electrical Engineering General Engineering Elective Compulsory Computational Science Computational Science	Core qualification Science (English e and Engineerin e and Engineerin	on: Compulso h program, 5 ng: Specialisat ng: Specialisat	7 semester): Specialisa ry 7 semester): Specialisat tion Computer Science: E tion Engineering Science Science: Elective Compu	tion Electric Elective Com s: Elective C	al Engineering pulsory
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Course L0781: EE Expe	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, Prof. Thorsten Kern	
Language	DE	
Cycle		
Content	lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines	
Literature	Wird in der Lehrveranstaltung festgelegt	

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

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

Courses					
Title Electronic Devices (L0720)			Typ Lecture	Hrs/wk 3	СР 4
Electronic Devices (L0721)			Project-/problem-based Learning	2	2
Module Responsible	Prof. Hoc Khiem Trieu				
Admission Requirements	None				
-	Atomic model and qu physics	uantum theory, electrical	currents in solid state ma	terials, basio	cs in solid-sta
Recommended Previous Knowledge	Successful participatic equivalent contents	on of Physics for Engineer	rs and Materials in Electrical	Engineering	or courses wi
Educational Objectives	After taking part succe	essfully, students have re	ached the following learning	results	
Professional Competence					
Knowledge	 Students are able to represent the basics of semiconductor physics, to explain the operating principle of important semiconductor devices, to outline device characteristics and equivalent circuits as well as to explain their derivation an to discuss the limitation of device models. 				
Skills	 Students are capable to apply devices in basic circuits, to realize the physical context and to solve complex problems by oneself 				
Personal Competence					
Social Competence	Students are able to p discuss the results in f		lab experiments in team wo	ork as well as	s to present a
Autonomy	Students are capable	to acquire knowledge bas	ed on literature in order to p	repare their	experiments.
Workload in Hours	Independent Study Tir	me 110, Study Time in Le	cture 70		
Credit points	6				
Course achievement	Compulsor B onus Yes 10 %	Form Subject theoretical practical work	Description Studierenden erarbeite zu einem bestimmte and dieses in Form eines und Diskussion. Dari Gruppe eine Übungsau jeweiligen Versuch geh	en Thema, Versuches m über hinaus fgabe, die in	demonstriere nit Präsentation betreut jeo
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Compulsory Electrical Engineering Engineering Science: 9	: Core qualification: Comp Specialisation Electrical E	am, 7 semester): Specialisa pulsory ngineering: Compulsory m, 7 semester): Specialisa		5

ourse L0720: Electron	ic Devices	
Түр	Lecture	
Hrs/wk		
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Hoc Khiem Trieu	
Language		
Cycle	WiSe	
Content	 Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram effective mass, density of state, probability of occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms drift current, diffusion current; equilibriums in semiconductor, semiconductor equations) pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode backward diode, photo diode, LED, laser diode) Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect breakdown, generation and recombination current and high injection; Ebers-Moll model: family c characteristics, equivalent circuit; frequency response, switching characteristics, heterojunction bipolar transistor) Unipolar devices (surface effects: surface states, work function, energy band diagram; metal semiconductor junctions: Schottky contact, current-voltage characteristics, small-signa model, breakdown characteristics; MESFET: operating principle, depletion mode an enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, strong 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) 	
Literature	 S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: P der Halbleiterbauelemente, Springer (2011) T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendu elektronischen Schaltungen, Springer (2004) B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005) D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011) re M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996) S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007) H. Schaumburg: Halbleiter, B.G. Teubner (1991) A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelem Carl Hanser (1992) HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikal Grundlagen der Halbleiterbauelemente, Vieweg (1985) 	

Course L0721: Electron	urse L0721: Electronic Devices		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
СР	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 Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
			-	-
Module Responsible	Prof. Herbert werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in tim	ne and frequency domain, Laplad	ce transform	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic sysparticular explain properties of first ar They can explain the dynamics of sim of frequency response and root locus They can explain the Nyquist stability They can explain the role of the phase They can explain the way a PID corresponse They can explain issues arising whimplemented digitally 	nd second order systems ple control loops and interpret of criterion and the stability marging e margin in analysis and synthes ontroller affects a control loop	lynamic prop ns derived f is of control in terms o	perties in terr rom it. loops f its frequen
Skills	 Students can transform models of linear dynamic systems from time to frequency domain a vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and freque response techniques They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks 			
Personal Competence				
Social Competence	Students can work in small groups to jointly controller designs	solve technical problems, and e	xperimental	ly validate the
	Students can obtain information from pr experiment guides) and use it when solving	ovided sources (lecture notes,		
Autonomy	They can assess their knowledge in weekly o	on-line tests and thereby control	their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German progr Bioprocess Engineering: Core qualification: C Computer Science: Specialisation Computati Data Science: Core qualification: Elective Co Electrical Engineering: Core qualification: Co Energy and Environmental Engineering: Core General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Engineering: Compulsory	Compulsory onal Mathematics: Elective Com mpulsory e qualification: Compulsory gram, 7 semester): Specialisat rogram, 7 semester): Specialisation	pulsory ion Electric lisation Civ on Bioproces	al Engineerir il Engineerir ss Engineerir

	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,
Assignment for the	Focus Aircraft Systems Engineering: Compulsory
Following Curricula	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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 0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
-	 Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	
	 Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability
	 Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants
	 Internal model principle Root locus techniques Root locus plots Root locus design of PID controllers
Content	 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 systemsRoot locus and frequency response of time delay systemsSmith 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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 M1502: E	lectromagnetics for Engineers	II: Time-Dependent F	ields	
Courses				
	eers II: Time-Dependent Fields (L2283) eers II: Time-Dependent Fields (L2284)	Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 5 1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Electrical Engineering I, Electrical Engineering II, Theoretical Electrical Engineering I Mathematics I, Mathematics II, Mathematics III, Mathematics IV			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They can assess the principal behavior and characteristics of quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-dependent electromagnetic fields and are able to explicate these.			
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of given time dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications.			
Personal Competence				
Social Competence	Students are able to work together on subject related tasks in small groups. They are able to presen their results effectively (e.g. during exercise sessions).			
Autonomy	Students are capable to gather necessary information from provided references and relate this information to the lecture. They are able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the lectures and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between acquired knowledge and ongoing research at the Hamburg University of Technology (TUHH), e.g. in the area of high frequency engineering and optics.			
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement				
Examination				
Examination duration and scale	120 min			
Assignment for the Following Curricula				

Тур	Lecture	
Hrs/wk		
СР	5	
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42	
Lecturer	Dr. Cheng Yang, 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	
content	- Reflection and refraction of planar waves at boundary surfaces	
	- Waveguide theory	
	- Rectangular waveguide, planar optical waveguide	
	- Elektrical and magnetical dipol radiation	
	- Simple arrays of antennas	
	The practical application of numerical methods will be trained within specifically prepared lectures i an interactive manner using small MATLAB programs.	
	- G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010)	
	- H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011)	
	- W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011)	
Literature	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)	
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)	
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)	

Тур	Recitation Section (small)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Cheng Yang, Prof. Christian Schuster
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
F itle Semiconductor Circuit Desig		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	Prof Matthias Kuhl			
Admission	Nono			
Requirements				
Recommended	Fundamentals of electrical engineer	Ing		
Previous Knowledge	Basics of physics, especially semiconductor physics			
ducational Objectives	After taking part successfully, stude	nts have reached the following learning	results	
Professional				
Competence				
Knowledge	 Students are able to explain the functionality of different MOS devices in electronic circuits. Students are able to explain how analog circuits functions and where they are applied. Students are able to explain the functionality of fundamental operational amplifiers and the specifications. Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages. Students have knowledge about memory circuits and can explain their functionality an specifications. Students know the appropriate fields for the use of bipolar transistors. 			
Skills	 Students can calculate the specifications of different MOS devices and can define the paramet of electronic circuits. Students are able to develop different logic circuits and can design different types of locircuits. Students can use MOS devices, operational amplifiers and bipolar transistors for spec applications. 		types of log	
Personal Competence	Students are able work efficie	ently in heterogeneous teams.		
Social Competence	 Students working together questions. 	in small groups can solve problems	and answe	er professiona
Autonomy	 Students are able to assess the students are able to assess are able to assess the students are able to assess are able to assesses are able to assess are able to assess are able to assesses	neir level of knowledge.		
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Course achievement Examination				
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineeri Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Mechatronics: Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Engineering Science: Specialisation Electrical Engineering: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineeri Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsor Gomputational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elect Compulsory		al Engineering al Engineering al Engineering	

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

ourse L0763: Semicor	nductor 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	
Cycle	SoSe
Content	 Repetition Semiconductorphysics and Diodes Functionality and characteristic curve of bipolar transistors Basic circuits with bipolar transistors Functionality and characteristic curve of MOS transistors Basic circuits with MOS transistors for amplifiers Operational amplifiers and their applications Typical applications for analog and digital circuits Realization of logical functions Basic circuits with MOS transistors for combinational logic Memory circuits Basic circuits with MOS transistors for sequential logic Basic concepts of analog-to-digital and digital-to-analog-converters
Literature	 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Τνρ	Recitation Section (small)		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Matthias Kuhl, Weitere Mitarbeiter		
Language	DE		
Cycle	SoSe		
Content	 Basic circuits and characteristic curves of bipolar transistors Basic circuits and characteristic curves of MOS transistors for amplifiers Realization and dimensioning of operational amplifiers Realization of logic functions Basic circuits with MOS transistors for combinational and sequential logic Memory circuits Circuits for analog-to-digital and digital-to-analog converters Design of exemplary circuits 		
Literature	 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo 		

Module M0734: Electrical Engineering Project Laboratory						
Courses						
Title		Тур	Hrs/wk	СР		
-	st Laboratory (LOG 40)	Project-/problem-based	8			
Electrical Engineering Proje		Learning	0	6		
	Prof. Christian Becker					
Admission Requirements	None					
	Electrical Engineering I, Electrical Engineering II					
Recommended						
Previous Knowledge						
Educational Objectives	After taking part successfully, students have read	hed the following learning	results			
Professional		5 5				
Competence						
	Students are able to give a summary of the t engineering and illustrate respective relationship					
Kanadada	relevant problems and questions using appropri	ate technical language. T				
Knowledge	process of solving practical problems and present	t related results.				
	l The students can transfer their fundamental kr	nowledge on electrical en	aineerina to	the process o		
	solving practical problems. They identify and	overcome typical problem	s during th	e realization o		
Skills	projects in the context of electrical engineering conceptual solutions for non-standardized problem	. Students are able to dev	elop, compa	are, and choose		
Personal Competence						
	Students are able to cooperate in small, mixe solutions to given problems in the context of elect					
	and explain their results alone or in groups in fro	nt of a qualified audience.	Students ha	ive the ability to		
Social Competence	develop alternative approaches to an electrical discuss advantages as well as drawbacks.	engineering problem inde	pendently o	r in groups and		
	uiscuss auvantages as well as urawbacks.					
	Students are capable of independently solvin					
	literature. They are able to fill gaps in as well as sources provided by the supervisor. Furthermore					
Autonomy	pragmatically solve them by means of correspond	ding solutions and concept	S.			
	Independent Study Time 68, Study Time in Lectur	re 112				
Credit points Course achievement						
	Subject theoretical and practical work					
Examination duration	based on task + presentation					
and scale	based on task + presentation					
	General Engineering Science (German program Compulsory	n, 7 semester): Specialisa	tion Electric	al Engineering		
Assignment for the	Electrical Engineering: Core qualification: Compulsory					
	General Engineering Science (English program		tion Electric	al Engineering		
	Compulsory Technomathematics: Specialisation III. Engineerir	a Science: Elective Comp	ilsorv			

ourse L0640: Electrical Engineering Project Laboratory				
Тур	Project-/problem-based Learning			
Hrs/wk	8			
СР	6			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Lecturer	Prof. Christian Becker, Dozenten des SD E			
Language	DE			
Cycle	SoSe			
Content	Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, power electronics based inverters, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.			
	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).			

Courses				
Fitle Management Tutorial (L088 ntroduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Bus	iness		
ducational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				_ ·
Knowledge	 After taking this module, students know Management, from Planning and Organis. Controlling. In particular they are able to explain the differences between Management and to name importa explain the most important aspect aspects of entreprneurial projects describe and explain basic busines chain management, organization a innovation management and mark explain the relevance of planning multiple objectives and uncertain Finance state basics from accounting and c 	ation to Marketing and Innovation, Economics and Management a nt definitions from the field of Mana so of and goals in Management and so functions as production, procure nd human ressource management eting and decision making in Busines nty, and explain some basic me osting and selected controlling met	and also to I and the sub agement d name the r ement and so , information s, esp. in si ethods from thods.	nvestment and p-disciplines i most importan purcing, supply management tuations unde mathematica
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 			
Personal Competence				
	Students are able to			
Social Competence	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project to communicate appropriately and to cooperate respectfully with their fellow students. 		rite a coheren	
	Students are able to			
Autonomy	work in a team and to organize theto write a report on their project.	team themselves		
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points				
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration	several written exams during the semeste	er		
	General Engineering Science (German pro Civil- and Environmental Engineering: Cor Civil- and Environmental Engineering: Spe Civil- and Environmental Engineering: Spe Civil- and Environmental Engineering: Spe Bioprocess Engineering: Core qualification Computer Science: Core qualification: Con Data Science: Core qualification: Compuls Electrical Engineering: Core qualification:	e qualification: Compulsory ecialisation Civil Engineering: Electi ecialisation Water and Environment ecialisation Traffic and Mobility: Ele- n: Compulsory npulsory eory	ve Compulso : Elective Co	ory mpulsory

I	Consul Environment Chinese (Environment 7 consistent), Consisting Electrical Environment
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	Construction Colored (Feelink and a 7 and also). Constallation Markeniael Feeline day
Following Curricula	
r onowing curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
1	Process Engineering: Core qualification: Compulsory

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

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

Specialization 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_2 separation in large power stations and, on the other, the growing supply of electricity from regenerative energy sources. Both these key developments in electricity generation are taken into consideration in designing the degree course. Not only for the CO_2 separation technologies but also for other environmental protection purposes, as for example air pollution protection, key qualifications in Chemistry play an important role. Conventional and renewable electricity generation technologies are covered in the degree more detailed but still under a generalist viewpoint.

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

Courses				
Title Computer Engineering (L03: Computer Engineering (L03:		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Module Responsible	, ,		-	-
i				
Recommended Previous Knowledge	Basic knowledge in electrical engineering			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence Knowledge	 This module deals with the foundations of t from the assembly-level programming down Introduction Combinational logic: Gates, Boole combinational networks Sequential logic: Flip floor, automated 	to gates. The module includes t ean algebra, Boolean functi systematic hardware design a, subtraction, multiplication and ramming models, MIPS single-cy , DRAM, caches	he following ons, hardw division vcle architec	topics: vare synthesi ture, pipelinin
Skills	The students perceive computer systems internal structure and the physical composi- highly specific and individual computers components. They are able to distinguish I today's computing systems - from gates and After successful completion of the module between a physical computer system and understand the consequences that the exer-	ition of computer systems. The can be built based on a col between and to explain the diff circuits up to complete process e, the students are able to ju d the software executed on i	students ca lection of f ferent abstra- ors. dge the int t. In particu	n analyze, ho ew and simp action layers erdependenci ular, they sh

layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.

Personal Competence

Social Competence Students are able to solve similar problems alone or in a group and to present the results accordingly.

Students are able to acquire new knowledge from specific literature and to associate this knowledge *Autonomy* with other classes.

Workload in Hours	Independent Study Ti	me 124, Study Tim	e in Lecture 56		
Credit points	6	-			
-	Compulsor B onus	Form	Description		
Course achievement	Yes 10 %	Excercises	Description		
E					
	Written exam				
Examination duration and scale	90 minutes, contents	of course and labs			
	General Engineering Compulsory	Science (German	program, 7 semester): Specialisation Compu	iter Science:
		Science (German	program, 7 semester): S	pecialisation Bioprocess	Engineering:
	General Engineering	Science (German	program, 7 semester): Specialisation Naval	Architecture:
		Science (Germai	n program, 7 semeste	r): Specialisation Civil	Engineering:
		Science (German	program, 7 semester):	Specialisation Electrical	Engineering:
		Science (German J	program, 7 semester): S	pecialisation Biomedical	Engineering:
			rogram, 7 semester): Sp	ecialisation Energy and	Enviromental
		,	program, 7 semester):	Specialisation Process	Engineering:
			program, 7 semester): S	pecialisation Mechanical	Engineering,
		Science (German p	program, 7 semester): S	pecialisation Mechanical	Engineering,
		Science (German p		pecialisation Mechanical	Engineering,
	Focus Aircraft System General Engineering			pecialisation Mechanical	Engineering,
	Focus Materials in Eng General Engineering			pecialisation Mechanical	Engineering,
	Focus Theoretical Med	chanical Engineerin	g: Compulsory	pecialisation Mechanical	
	Focus Product Develo	pment and Product	ion: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory			Engineering,	
	Computer Science: Co				
Assignment for the	Electrical Engineering	: Core qualification	Compulsory	. Cassieliestica Commu	
Following Curricula	General Engineering	Science (English	program, / semester)	: Specialisation Compu	ter Science:
Following curricula		Science (English r	rogram 7 semester) [,] S	pecialisation Bioprocess	Engineering
	Compulsory	Science (English p	iogram, 7 semester). S	pecialisation bioprocess	Engineering.
	General Engineering	Science (English	program, 7 semester)	: Specialisation Naval	Architecture:
	Compulsory	Caianaa (English			
	Compulsory			r): Specialisation Civil	
	General Engineering Compulsory	Science (English	program, 7 semester):	Specialisation Electrical	Engineering:
	General Engineering	Science (English p	rogram, 7 semester): S	pecialisation Biomedical	Engineering:
			rogram, 7 semester): Sp	ecialisation Energy and	Enviromental
		,	program, 7 semester):	Specialisation Process	Engineering:
			rogram, 7 semester): S	pecialisation Mechanical	Engineering,
		Science (English p	rogram, 7 semester): S	pecialisation Mechanical	Engineering,
		Science (English p		pecialisation Mechanical	Engineering,
		Science (English p	rogram, 7 semester): S	pecialisation Mechanical	Engineering,
	Focus Materials in Engineering			nocialization Machanizat	Engineerin
	Focus Theoretical Med	chanical Engineerin	g: Compulsory	pecialisation Mechanical	
	General Engineering Focus Product Develo			pecialisation Mechanical	Engineering,
	l				

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

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

Module M0933: F	undamentals of Materials Science	1		
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials S	Science I (L1085)	Lecture	2	2
Fundamentals of Materials S Composites) (L0506)	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
	s of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	itics		
Educational Objectives	 After taking part successfully, students have reacl	hed the following l	learning results	
Professional Competence				
	The students have acquired a fundamental kno	wledge on metals	s, ceramics and po	lymers and ca
Knowledge	describe this knowledge comprehensively. Fundamental knowledge here means specifically the issue of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanica properties. The students know about the key aspects of characterization methods for materials and ca identify relevant approaches for characterizing specific properties. They are able to trace material phenomena back to the underlying physical and chemical laws of nature.			
Skills	The students are able to trace materials phenomena back to the underlying physical and chemical law of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, an stiffness, chemical properties such as corrosion resistance, and to phase transformations such a solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure o the material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Course achievement				
Examination				
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Engineering: Compulsory Energy and Environmental Engineering: Core qual General Engineering Science (English program, Compulsory General Engineering Science (English program, Engineering: Compulsory Logistics and Mobility: Specialisation Engineering Mechanical Engineering: Core qualification: Comp	7 semester): Spe n, 7 semester): Spec ification: Compuls 7 semester): Spec 7 semester): Spe n, 7 semester): Spec n, 7 semester): Spec Science: Elective (ecialisation Biomedia Specialisation Nav cialisation Energy ar cialisation Mechanic ecialisation Biomedia Specialisation Nav cialisation Energy ar	cal Engineering al Architecture ad Enviromenta cal Engineering cal Engineering al Architecture
	Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineerin	/	e Compulsory	

Course L1085: Fundam	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			
	Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7		

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

Course L1095: Physical	and Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Müller
Language	DE
Cycle	WiSe
Content	 Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	 Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer

Courses							
Title Embodiment Design and 3D	-CVD (10268))			Typ Lecture	Hrs/wk 2	СР 1
)			Project-/problem-based	2	2
Mechanical Design Project I (L0695) Mechanical Design Project II (L0592)					Learning Project-/problem-based	3	2
Learning Project-/problem-based					1		
					Learning		
Module Responsible Admission		Krause					
Requirements	None						
Recommended Previous Knowledge	MechFund	nanics	of Mechanical Engineeri of Materials Science ineering	ng Des	sign		
Educational Objectives	After taking	part succe	essfully, students have	eache	ed the following learning	results	
Professional Competence							
competence	After passir	ng the mod	ule, students are able t) :			
Knowledge	 explain design guidelines for machinery parts e.g. considering load situation, materials an 						
Skills	 After passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. 						
Personal Competence							
Social Competence	 After passing the module, students are able to: develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 						
	Students ar	e able					
Autonomy	 to estimate their level of knowledge using activating methods within the lectures (e.g. wit clickers), To solve engineering design tasks systematically. 						
Workload in Hours	Independer	nt Study Tir	me 40, Study Time in Le	cture	140		
Credit points	6						
Course achievement	Compulso Yes Yes Yes Yes	rBonus None None None None	Form Written elaboration Written elaboration Written elaboration Written elaboration		Description Teamprojekt Konstrukt Konstruktionsprojekt 1 Konstruktionsprojekt 2 3D-CAD-Praktikum		<
Examination		m					
Examination duration and scale	180						
Assignment for the Following Curricula	Compulsory General En Compulsory General En Engineering Energy and General En Compulsory	gineering gineering g: Compuls Environme gineering gineering	Science (German progr Science (German progr ory ental Engineering: Core Science (English progr	am, 7 am, 7 qualifi am, 7	semester): Specialisati ' semester): Specialisati semester): Specialisatic ication: Compulsory semester): Specialisati semester): Specialisati	ion Biomedic on Energy an on Mechanic	al Engineerin d Enviroment al Engineerin

General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

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

Course L0695: Mechani	cal Design Project I			
Тур	Project-/problem-based Learning			
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	 Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet 			
Literature	 Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. 			

Course L0592: Mechan	ical Design Project II
Course L0392. Mechan	
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	SoSe
Content	 Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing)
Literature	Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag. Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag. Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag. Einführung in die DIN-Normen, Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.

Course L0267: Team Pr	oject Design Methodology		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	rof. Dieter Krause		
Language	DE		
Cycle	SoSe		
Content	 Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides 		
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen 		

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Courses						
Title Fundamentals of Fluid Mech	nanics (L0091)		Typ Lecture	Hrs/wk 2	CP 4	
Fluid Mechanics for Process	, ,		Recitation Section (la		2	
Module Responsible	Prof. Michael Schlüter					
Admission Requirements	None					
Recommended Previous Knowledge	 Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration 					
Educational Objectives	After taking part succe	essfully, students h	nave reached the following lear	ning results		
Professional Competence	Students are able to:					
Knowledge	 give an overvious engineering 	explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary				
Skills	 The students are able to describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering 					
Personal Competence						
Social Competence	information to the able to work to results effective	he context of the l gether on subject ly in English (e.g. < out solutions for	from subject related, profession ecture and related tasks in small groups during small group exercises) exercises by themselves, to di	. They are able	to present the	
	The students are able	to				
Autonomy			copic and to expand their know wn and to evaluate their actual			
Workload in Hours	Independent Study Tin	ne 124, Study Tim	e in Lecture 56			
Credit points	6					
Course achievement	CompulsorBonus Yes 5 %	Form Midterm	Description			
	Written exam					
Examination duration and scale	3 hours					
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulso Bioprocess Engineering Energy and Environme General Engineering Compulsory General Engineering S Compulsory	Science (German icience (German p ory g: Core qualificatio ental Engineering: Science (English Science (English p Science (English p ory	Core qualification: Compulsory program, 7 semester): Spec program, 7 semester): Special rogram, 7 semester): Specialis	isation Bioproce sation Energy a ialisation Proce isation Bioproce sation Energy a	ess Engineering nd Enviroment ess Engineering ess Engineering	

Process Engineering: Core qualification: Compulsory

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

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

Module M0610: E	lectrical Machines and Actu	ators			
Courses					
Title		Тур	Hrs/wk	СР	
Electrical Machines and Actu Electrical Machines and Actu		Lecture Recitation Section (large)	3 2	4 2	
Module Responsible	Prof. Thorsten Kern				
Admission Requirements	None				
Recommended	Basics of mathematics, in particular com	plexe numbers, integrals, differentia	als		
	Basics of electrical engineering and mec	hanical engineering			
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results		
Professional Competence					
	Students can to draw and explain the ba	asic principles of electric and magne	etic fields.		
Knowledge	They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the majo parameters of the energy efficiency of the whole system from the power grid to the driven engine.				
	Students arw able to calculate two-dimensional electric and magnetic fields in particular ferromagneti circuits with air gap. For this they apply the usual methods of the design auf electric machines.				
Skills	They can calulate the operational performance of electric machines from their given characteristic dat. and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.				
Personal Competence Social Competence Autonomy		I performance of electric machines			
Workload in Hours	I Independent Study Time 110, Study Tim	e in Lecture 70			
Credit points					
Course achievement					
	Written exam				
Examination duration and scale	120 Minutes				

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

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

Module M0618: R	enewables and Energy Syste	ms			
Courses					
Title Power Industry (L0316) Energy Systems and Energy Renewable Energy (L0313) Renewable Energy (L1434)	r Industry (L0315)	Typ Lecture Lecture Lecture Recitation Section (small)	Hrs/wk 1 2 2 1	CP 1 2 2 1	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	none				
	After taking part successfully, students ha	ve reached the following learning	results		
Professional Competence					
	With completion of this module, the students can provide an overview of characteristics of energ systems and their economic efficiency. They can explain the issues occurring in this context Furthermore, they can explain details of power generation, power distribution and power trading wil regard to subject-related contexts. The students can explain these aspects, which are applicable t many energy systems in general, especially for renewable energy systems and critical discuss them Furthermore, the students can explain the environmental benefits from the use of such systems.				
Skills	Students are able to apply methodologies for detailed determination of energy demand or ener production for various types of energy systems. Furthermore, they can evaluate energy syster technically, environmentally and economically and design them under certain given condition Therefore, they can choose the necessary subject-specific calculation rules, also for not standardiz solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field renewable energies orally and to put them them into the right context.				
Personal Competence					
Social Competence	The students are able to analyze suitable technical alternatives and to assess them with technic economical and ecological criteria under sustainability aspects. This allows them to make an effectir contribuition to a more sustainable power supply.				
Autonomy	Students can independently exploit sourc and transform it to new questions.	es , acquire the particular knowle	dge about t	the subject area	
Workload in Hours	Independent Study Time 96, Study Time ir	n Lecture 84			
Credit points					
Course achievement					
Examination Examination duration and scale	Written exam 3 hours written exam				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory Process Engineering: Core qualification: Compulsory				

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

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

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

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

Module M0655: C					
Courses					
Title Computational Fluid Dynam		Typ Lecture	Hrs/wk 2	CP 3	
Computational Fluid Dynam		Recitation Section (large)	2	3	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	 Mathematical Methods for E Fundamentals of Differentia 	ngineers l/integral calculus and series expansions			
Educational Objectives	After taking part successfully, stuc	lents have reached the following learning	results		
Professional					
Competence Knowledge	The students are able to list the basic numerics of partial differential equations.				
Skills	The students are able develop appropriate numerical integration in space and time for the governir partial differential equations. They can code computational algorithms in a structured way.				
Personal Competence	The students can arrive at work re	sults in groups and document them.			
Autonomy	The students can independently a	nalyse approaches to solving specific prob	lems.		
Workload in Hours	Independent Study Time 124, Stud	ly Time in Lecture 56			
Credit points		·			
Course achievement	None				
Examination					
Examination duration and scale	2h				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromer Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architectu Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Energy Systems: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromer Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromer Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromer Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromer Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineeri Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectu Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectu Compulsory Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				

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

Course L0419: Computa	ourse L0419: Computational Fluid Dynamics I			
Тур	Recitation Section (large)			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Thomas Rung			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Courses							
Fitle Practical Course: Measurem Measurement Technology fo Measurement Technology fo	or Mechanical Engineering	g (L1116)		Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	CP 2 3 1	
Module Responsible							
Admission							
Requirements							
Recommended Previous Knowledge	Basic knowledge of phy	ysics, chemistry and	delectric	cal engineering			
ducational Objectives	After taking part succe	ssfully, students ha	ve reacł	ned the following learning	results		
Professional Competence	Students are able to na			dmentals of the Measurer			
Knowledge	They can outline the maesured (Electrical Q	and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems). They can outline the most important measuring methods for different kinds of quantities to b maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency). They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Ga Chromatography)					
Skills	Students can select suitable measuring methods to given problems and can use refering measuremen devices in practice. The students are able to orally explain issues in the subject area of measurement technology an solution approaches as well as place the issues into the right context and application area.						
Personal Competence							
Social Competence	Students can arrive at work results in groups and document them in a common report.						
Autonomy	Students are able to fa	miliarize themselve	s with n	ew measurement technol	ogies.		
	Independent Study Tim	ne 110, Study Time	in Lectu	re 70			
Credit points	-	Eorm		Description			
Course achievement	Compulsor B onus Yes None	Form Subject theoret practical work	ical a	Description nd			
	Written exam						
Examination duration and scale	105 minutes						
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulso Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory	Science (German pro- cience (German pro- pry ineering: Core quali intal Engineering: Co pecialisation Mecha pecialisation Mecha pecialisation Biome science (English pro- Science (English pro- Science (English pro- science (English pro- science (English pro- science (English pro-	ogram, ogram, fication: ore qual tronics: inical En dical En ogram, ogram, ogram, ogram, ram, 7 s ogram,	ification: Compulsory Compulsory	on Biomedia n Energy ar Ilsory n Energy ar on Mechanic on Biomedia Mechatronic: on Mechanic	cal Engineeri nd Enviromer nd Enviromer cal Engineeri cal Engineeri s: Compulsor cal Engineeri	

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

urse L1116: Measure	ement Technology for Mechanical Engineering			
Тур	Lecture			
Hrs/wk	2			
СР	3			
	Independent Study Time 62, Study Time in Lecture 28			
	Prof. Thorsten Kern, Dennis Kähler			
Language Cycle				
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			
Content	2.4 Oscilloscope			
	2.5 Analog-to-Digital Conversion			
	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			
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer 2006, ISBN: 978-3-540-34055-3.			
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978 3486217940.			

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

Module M1275: E	nvironmental Te	echnology				
Courses						
Title Practical Exercise Environm				Hrs/wk 1 2	CP 1 2	
Module Responsible	Prof. Martin Kaltschmit	t				
Admission Requirements	None					
Recommended Previous Knowledge	Fundamentals of inorga	anic/organic chemistry a	nd biology			
Educational Objectives	After taking part succes	ssfully, students have re	eached the following lear	ning results		
Professional Competence						
Knowledge	technology. They are a	With the completion of this modul the students obtain profound knowledge of environmental technology. They are able to describe the behaviour of chemicals in the environment. Students can give an overview of scientific disciplines involved. They can explain terms and allocate them to related methods.				
Skills	Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.					
Personal Competence						
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation.					
Autonomy		Students can independently exploit sources about of the subject, acquire the particular knowledge and tranfer it to new problems.				
Workload in Hours	Independent Study Tim	ne 48, Study Time in Leo	ture 42			
Credit points	3					
Course achievement	Compulsor₿onus Yes None	Form Subject theoretical practical work	Description and			
Examination	Written exam					
Examination duration and scale	1 hour					
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory Process Engineering: Core qualification: Elective Compulsory					

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

nental Technologie
Lecture
2
2
Independent Study Time 32, Study Time in Lecture 28
Prof. Martin Kaltschmitt, Dozenten des SD V
DE
WiSe
 Introductory seminar on environmental science: Environmental impact and adverse effects Wastewater technology Air pollution control Noise protection Waste and recycling management Soil and ground water protection Renewable energies Resource conservation and energy efficiency
Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972- 5 (ISBN)

Courses					
Title Gas and Steam Power Plant Gas and Steam Power Plant	. ,		Typ Lecture Recitation Section (lare	Hrs/wk 3 ge) 1	CP 5 1
			Recitation Section (larg	Je) 1	1
Module Responsible Admission Requirements					
Recommended Previous Knowledge	"Hoot Transfor"				
Educational Objectives	After taking part succe	essfully, students have	e reached the following learn	ing results	
Professional					
Competence					
Knowledge	The students can evaluate the development of the electricity demand and the energy conversion rou in the thermal power plant, describe the various types of power plant and the layout of the ster generator block. They are also able to determine the operation characteristics of the power pla Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities conventional fossil-fuelled power plants with solar thermal and geothermal power plants or pla equipped with Carbon Capture and Storage.				
	The students have bas	sic knowledge about tl	ne principles, operation and	design of turboi	machinery
Skills	The students will be able, using theories and methods of the energy technology from fossil fuels at 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 conceptu solutions. Through analysis of the problem and exposure to the inherent interplay between heat at 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 basi the students become the ability to follow better the deliberations on the electricity mix composities 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 TM . With this tool small practical tasks are solved with the PC, to highlight aspect of the design and development of power plant cycles.				
Personal Competence	component or at stage	•	ations on turbomachinery ei		a piant, as sin
reisonal competence		he framework of the	lecture is planned for stu	dents that are	interested. T
Social 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 obtain first-hand experience with a power plant in operation and gain insights into the conflict between technical and political issues. The students assisted by the tutors will be able to develop alone simple simulation models and run wi				
Autonomy	these scenario analys consolidated and the highlighted. The stud	es. In this manner the potential effects from ents are able independent	ne theoretical and practical n different process combina ndently to analyse the ope tes and characteristic curves	knowledge from tions and bour rational perforr	m the lecture dary conditio
Workload in Hours	Independent Study Tir	me 124, Study Time in	Lecture 56		
Credit points	· · · · · · · · · · · · · · · · · · ·	-			
	CompulsorBonus	Form	Description		
Course achievement	No 5 %	Excercises Attestation	10 Übungsaufgaber Minuten; bis zu 5 % Abgaben 15-minütiges, unbe Professional; nur (keine anteiligen Pu	6 Bonus je nach enotetes Testat bestanden/nie	Anteil richtig über EBSILC
Examination	Written exam				
Examination duration and scale		f 120 min			
and scale	General Engineering S Engineering: Elective (Science (German prog Compulsory Science (German prog	ram, 7 semester): Specialis gram, 7 semester): Speciali		

Assignment for the Following Curricula Following Curricula Benergy Systems: Technical Complementary Course Core Studies: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Tvn	Lecture
Hrs/wk	
CP	
-	
	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 st 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 materials for power plants Location of power plants Solar thermal plants/geothermal plants/Carbon Capture and Storage plants. These are complemented in the 2 nd part of the module by the more specialised issues: Energy balance of a turbomachine Theory of turbine and compressor stage Equal and positive pressure blading Flow losses 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	 Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwer Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Tvn	Recitation Section (large)
Hrs/wk	
CP	
-	
	Independent Study Time 16, Study Time in Lecture 14
	Prof. Alfons Kather
Language	
Cycle	
Content	In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plan 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 • Hydraulic fluid-flow machines • Pump and water turbine designs • Design examples of reciprocating engines and turbomachinery • Steam power plants • Gas turbine systems • Diesel engine systems • Diese flow per plant block • Individual elements of the power Plants • Types of Power Plant • Layout of the power plant block • Individual elements of the power plant • Cooling systems • Flue gas cleaning • Operation characteristics of the power plant • Location of power plants The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting cline effects are a special focus of the lecture and the lecture hall exercise. The challenges in plant opera from interconnecting conventional power plants and renewable energy sources are discussed and technical options for providing security of supply and network stability are presented, also u consideration of cost effectiveness. In this critical review, focus is especially placed on the compatit of the different solutions with the environment and climate. With this, the awareness for responsibility of an engineer's own actions are emphasized and the potential extent of the differ solutions presented clearly. Within the fra
Literature	 Skripte Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
			-	-
Module Responsible	Prof. Herbert werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in tim	e and frequency domain, Lapla	ce transform	I
Educational Obiectives	 After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in term of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequent response They can explain issues arising when controllers designed in continuous time domain a implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain a vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequer response techniques They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks 			
Personal Competence	Students can work in small groups to jointly	solve technical problems, and e	xperimental	lv validate th
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate th controller designs Students can obtain information from provided sources (lecture notes, software documentat experiment guides) and use it when solving given problems.			
Autonomy	They can assess their knowledge in weekly c		their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German progr. Bioprocess Engineering: Core qualification: C Computer Science: Specialisation Computati Data Science: Core qualification: Elective Co Electrical Engineering: Core qualification: Co Energy and Environmental Engineering: Core General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English progr Engineering: Compulsory	compulsory onal Mathematics: Elective Com mpulsory e qualification: Compulsory gram, 7 semester): Specialisat rogram, 7 semester): Specialisation	pulsory ion Electrica lisation Civ on Bioproces	al Engineerir il Engineerir ss Engineerir

	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,
Assignment for the	Focus Aircraft Systems Engineering: Compulsory
Following Curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core gualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory
	Process Engineering: Core qualification: Compulsory

Course 10654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
_	 Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
<u>_</u>	Signals and systems
	 Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability
	Feedback systems
	 Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle
	Root locus techniques Root locus plots Root locus design of PID controllers
Content	 Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control
	 Time delay systems Root locus and frequency response of time delay systems Smith predictor
	Digital control
	 Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Software tools
	 Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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				
Fitle Thermal Separation Process Thermal Separation Process Thermal Separation Process Separation Processes (L1159	es (L0119) es (L0141)	Typ Lecture Recitation Section (small) Recitation Section (large) Practical Course	Hrs/wk 2 2 1 1	CP 2 2 1
Module Responsible			_	_
Admission				
Recommended Previous Knowledge	Recommended requirements: Thermodynan	nics III		
ducational Objectives	 After taking part successfully, students have	e reached the following learning	results	
Professional Competence				resses such
Knowledge	 distillation, extraction, and adsorption The students develop an understan process, the estimation of the energy 	n ding for the course of concent y demand of a process, the pos ns	ration durir ssibilities of	ig a separati energy savir
	 Using the gained knowledge the students can select a reasonable system boundary for a separation process and can close the associated energy and material balances The students can use different graphical methods for the designing of a separation process define the amount of theoretical stages required They can select and design a basic type of thermal separation process for a given case basis the advantages and disadvantages of the process The students are capable to obtain independently the needed material properties appropriate sources (diagrams and tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical background and the content of the experim work with the teachers in colloquium. 		ion process a n case based properties fro b work. ne experimen tures and use	
Personal Competence				
Social Competence	 The students can work technical assi in the tutorial The students are able to carry out p division of labor between them. The scientifically in a report. 	ractical lab work in small group	s and organ	ize a functior
Autonomy	 The students are capable to obtain the needed information from suitable sources by themselv and assess their quality The students can proof the state of their knowledge with exam resembling assignments and this way control their learning process 			
Workload in Hours	Independent Study Time 96, Study Time in I	ecture 84		
Credit points				
Course achievement	None			
Examination				
Examination duration	120 minutes; theoretical questions and calc			

Assignment for the Following Curricula	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 Energy and Environmental Engineering: Core qualification: 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 General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0118: Thermal	Separation Processes
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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

Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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

Typ Recitation Section (large)		
Hrs/wk		
CP		
_		
	Prof. Irina Smirnova	
Language		
Cycle		
Content	 Introduction in the thermal process engineering and to the main features of separatic processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 	
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 17985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th experimental of McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie 	

Tree	Practical Course
	Practical Course
Hrs/wk CP	
_	
	Independent Study Time 16, Study Time in Lecture 14
	Prof. Irina Smirnova
Language	
Cycle	 Wise 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. The students work small groups with a high degree of division of labor. For every experiment, the students work and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation processes Membrane separation Energy demand of separation processes Selection of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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

Courses Typ Hrs/wk CP Hest and Mass Transfer (0.010) Lecture 2 2 2 Module Responsible Frof. Irina Smirnova Recitation Section large) 1 2 Module Responsible Frof. Irina Smirnova None Recitation Section large) 1 2 Module Responsible Frof. Irina Smirnova None Recitation Section large) 1 2 Recommended Basic knowledge: Technical Thermodynamics Professional Recommended Recitation Section large) 1 2 Profusional Competence The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g. cheat exchanger, chemical reactors). They are capable of explaining qualitative and tetermining quantitative heat transfer mechaning methy heat conducton, heat transfer and them activation and to describe com linked processes in detail. Knowledge The students are capable of explaining qualitative and tetermining quantitative heat transfer mechaning requirements Knowledge The students are capable to det transfer problems Indeal and the processes in detail. Knowledge The students are capable to solve specific heat transfer problem for mass transfer and to describe com linked a	Module M0538: H	eat and Mass Transfer			
Heat and Mass Transfer (1010) 1 2 2 Heat and Mass Transfer (1010) Rectilation Section (large) 1 2 Module Responsible Prof. Irina Smirnova Admission 3 Module Responsible Prof. Irina Smirnova Admission 3 Requirements Basic knowledge 2 2 Provious Knowledge Basic knowledge 2 2 Educational Objectives Atter taking part successfully, students have reached the following learning results Professional Provious Knowledge - The students are capable of explaining qualitative and determining quantitative heat transfer mochani - The students are capable of disliguish and characterize different kinds of heat transfer mechani Professional - The students are capable of disliguish and characterize different kinds of heat transfer mechani - The students are able to set reasonable system boundaries for a given fransport problem using the gained knowledge and to calculate the corresponding energy and mass fragectively. More are able to disliguish end to calculate the corresponding the processe in detail. - The students are able to set reasonable system boundaries for a given fransport problem using the gained knowledge for the description and design of apparatus (e.g., extractor columetation indus) and calculate the corresponding theres. Statis - The students are capable to solve specif	Courses				
Module Responsible Admission Requirements Recommended Provious Knowledge Prof. Irina Smirnova Recommended Provious Knowledge Basic knowledge: Technical Thermodynamics Recommended Provious Knowledge After taking part successfully, students have reached the following learning results Professional Competence The students are capable of exclaining qualitative and determining quantitative heat transfer proceducal apparatus (e.g. heap acchinger, cliencial reactors). Rowledge The students are capable of exclaining qualitative and determining quantitative heat transfer proceducal apparatus (e.g. heapt acchinger, cliencial reactors). Rowledge The students are capable of exclaining qualitative by using suitable mass transfer mechani namely heat conduction, heat transfer and thermal relation. Were students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding nergy and mass fra- merger and transfer problems (e.g. heated chemical react therperature alteriation in fluid) and to calculate the corresponding heat flows. Using dimensionless quantities, the students are capable to choose and design of apparatus (e.g. extraction colume.) Stills Stills Stills Personal Competence Autonomy Stills Autonomy Autonomy In the students are capable to work on subject-speci	Heat and Mass Transfer (L01 Heat and Mass Transfer (L01	.02)	Lecture Recitation Section (small)	2 1	2 2
Admission Requirements Previous Knowledge None Basic knowledge Basic knowledge: Technical Thermodynamics Previous Knowledge After taking part successfully, students have reached the following learning results Professional Competence The students are capable of explaining qualitative and determining quantitative heat transfer mechanics procedural apparatus (e.g. heat exchanger, chemical reactors). They are capable of disfinuush and characterize different kinds of heat transfer mechanic procedural apparatus (e.g. heat exchanger, chemical reactors). They are capable of disfinuush and characterize different kinds of heat transfer mechanic procedural apparatus (e.g. heat exchanger, chemical reactors). They are capable to depict the analogy between heat- and mass transfer in detail an describe mass transfer qualitative and quantitative by using suitable mass transfer thereises. The students are able to set reasonable system boundaries for a given transport problem using the gained knowledge and to balance the corresponding neetfork. Using dimensionless quantities, the students can execute scaling up of technical processe apparatus. They are able to distinguish between diffusion, convective mass transfer and mass trans- respectively.			Recitation Section (large)	T	2
Requirements None Recommended Previous Knowledge Basic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence The students are capable of explaining qualitative and determining quantitative heat transfer mechaninamely heat conduction, heat transfer and thermal radiation. They are capable of distinguish and characterized different kinds of heat transfer mechaninamely heat conduction, heat transfer and thermal radiation. They are able to depict the analogy between heat: and mass transfer and to describe complinked processes in detail. 	Admission				
Recommended Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence • The students are capable of explaining qualitative and determining quantitative heat transfer procedural apparatus (e.g. heat exchanger, chemical reactors). • They are capables of disfunguish and characterize different kinds of heat transfer mechani namely heat conduction, heat transfer and thermal radiuble. • Knowledge • The students are capable to explaining qualitative and quantitative by using suitable mass transfer theories. • They are capable to depict the analogy between heat- and mass transfer and to describe complinked processes in detail. • The students are able to set reasonable system boundaries for a given transport problem using the galaned knowledge and to balance the corresponding neergy and mass f respectively. • The students are able to solve specific heat transfer problems (e.g. heated chemical react themperature alteration in fluids) and to calculate the corresponding heat flows. • Using dimensionless quantities, the students can execute scaling up of technical process apparatus. • The students are capable to choose and design of apparatus (e.g. extraction colume traditional considering their advantages and disadvanta respectively. • In this context, the students are capable to conset their knowledge obtained in this course with knowledge other courses (in particular the courses thermodynamics, fluid mechanics and chemical proc apparatus. • The students are capable to mork on subject-specific challenges in		None			
Professional Competence The students are capable of explaining qualitative and determining quantitative heat transfer mechaninamely heat conduction, heat transfer mechaninamely heat conduction, heat transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and describe mass transfer qualitative and quantitative by using suitable mass transfer theories. The students are able to set reasonable system boundaries for a given transport problem using the galaned knowledge and to balance the corresponding neargy and mass for expectively. The students are able to set reasonable system boundaries for a given transport problem using the galaned knowledge and to balance the corresponding neargy and mass for expectively. The students are able to set reasonable system boundaries for a given transport problem using the galaned knowledge for the description and design of apparatus (e.g. extraction columing). The students are able to set reasonable system boundaries (e.g. extraction columing). They are able to distinguish between diffusion, convective mass transition and mass transfer rolenament types of heat reactionation. In this context, the students are capable to choose and design fundamental types of heat reactionary. In addition, they can calculate both, steady-state and non-steady-state processes in proceed apparatus. The students are capable to connect their knowledge obtained in this course with knowledge other courses (in particular the course sthermodynamics, fluid mechanics and chemical processe courses (in particular the course at heat and other students. Personal Competence The students are capable to work on subject-specific challenges in te	Recommended	Basic knowledge: Technical Thermodynar	mics		
Competence	Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Procedural apparatus (e. g. heat exchanger, chemical reactors). Interpretation (interpretation) Knowledge Knowledge Interpretation (interpretation) Interpretation (interpretation) Interpretation) Intettion) <					
Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Course achievement None Examination Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Course achievement Karamination duration 120 minutes: theoretiral nuestions and calculations	Knowledge	 procedural apparatus (e. g. heat ex They are capable of distinguish a namely heat conduction, heat tran The students have the ability to describe mass transfer qualitative They are able to depict the analog 	xchanger, chemical reactors). and characterize different kinds of sfer and thermal radiation. explain the physical basis for ma and quantitative by using suitable	heat trans ss transfer mass transf	fer mechanism in detail and er theories.
Social Competence The students are capable to work on subject-specific challenges in teams and to present results orally in a reasonable manner to tutors and other students. The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying proceed continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Mone Examination duration Yritten exam 	Skills	 using the gained knowledge ar respectively. They are capable to solve specitiemperature alteration in fluids) ar Using dimensionless quantities, the apparatus. They are able to distinguish between the tractification column). In this context, the students are compass exchanger for a specific a respectively. In addition, they can calculate bot apparatus. The students are capable to connect other courses (In particular the comparison other courses) 	nd to balance the corresponding ific heat transfer problems (e.g. nd to calculate the corresponding h ne students can execute scaling u reen diffusion, convective mass tra- ne description and design of appara capable to choose and design fund pplication considering their advan- th, steady-state and non-steady-st ect their knowledge obtained in thi urses thermodynamics, fluid mech	g energy a heated che eat flows. p of technic ansition and itus (e.g. ext damental ty ntages and ate processo s course wi	nd mass flo mical reactor al processes mass transfe craction colum pes of heat ar disadvantage es in procedur th knowlegde
Social Competence results orally in a reasonable manner to tutors and other students. Autonomy • The students are able to find and evaluate necessary information from suitable sources • They are able to prove their level of knowledge during the course with accompanying process continuously (clicker-system, exam-like assignments) and on this basis they can control to learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Course achievement None Examination duration Written exam Iz20 minutes: theoretical guestions and calculations	Personal Competence				
Autonomy They are able to prove their level of knowledge during the course with accompanying proceed continuously (clicker-system, exam-like assignments) and on this basis they can control the learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points Course achievement None Examination duration Uritten exam 120 minutes: theoretical questions and calculations.	Social Competence	•		teams and	to present th
Credit points 6 Course achievement None Examination Written exam Examination duration 120 minutes: theoretical questions and calculations	Autonomy	 They are able to prove their level of continuously (clicker-system, exar 	of knowledge during the course wi	th accompai	nying procedu
Course achievement None Examination Written exam Examination duration 120 minutes: theoretical questions and calculations	Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Examination Written exam Examination duration 120 minutes: theoretical questions and calculations					
Examination duration	Course achievement	None			
LIZU MINUTES: TREOFETICAL QUESTIONS AND CALCULATIONS	Examination	Written exam			
	Examination duration and scale	120 minutes; theoretical questions and ca	alculations		

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

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

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

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

Module M0891: Ir	nformatics for Process Engin	neers			
Courses					
Title		Тур	Hrs/wk	СР	
Informatics for Process Engi	neers (L0836)	Lecture	2	2	
Informatics for Process Engi		Recitation Section (small)	2	2	
Numeric and Matlab (L0125		Practical Course	2	2	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge in using MS Windows.				
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results		
Professional					
Competence		iest eviented concerts			
	Students can describe procedural and ob	oject-orientea concepts.			
Knowledge					
-					
	Students are capable of object-oriented mathematic questions by using Matlab.	programming in the programing la	nguage Java	a and of solvin	
Skills	Students are capable of developing conc	epts (simple algorithms) to solve te	chnical ques	stions.	
Personal Competence					
Eacial Compotence	Students are able to work out solutions t	ogether in small groups.			
Social Competence					
	Students are able to assess acquired skil	ls by applying it in practice			
Autonomy	Students are able to assess acquired skills by applying it in practice.				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84			
Credit points					
Course achievement					
	Written exam				
Examination duration and scale	90 min				
	General Engineering Science (German p	orogram, 7 semester): Specialisatio	n Energy ar	nd Enviromenta	
	Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering:				
	Elective Compulsory				
Assignment for the	Bioprocess Engineering: Core qualification: Compulsory				
Following Curricula	Energy and Environmental Engineering: General Engineering Science (English p		n Energy ar	d Enviroment:	
	Engineering: Elective Compulsory				
	General Engineering Science (English Elective Compulsory	program, 7 semester): Specialisa	ation Proce	ss Engineering	
	Process Engineering: Core qualification: (Compulsory			

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

Course L0837: Informatics 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: Numerio	and Matlah
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	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Module M0670: P	article Technol	ogy and Solid	ls Process Engineeri	ing	
Courses					
Title			Тур	Hrs/wk	СР
Particle Technology I (L0434 Particle Technology I (L0435			Lecture Recitation Section (sr	2 mall) 1	3 1
Particle Technology I (L043)			Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements	None				
Recommended Previous Knowledge	keine				
Educational Objectives	After taking part succ	essfully, students h	ave reached the following lear	ning results	
Professional Competence					
	After successful comp	letion of the modul	e students are able to		
Knowledge			unit-operations of solids proce ributions and to discuss their		
Skills	 Students are able to choose and design apparatuses and processes for solids processing according to the desire solids properties of the product asses solids with respect to their behavior in solids processing steps document their work scientifically. 				
Personal Competence					
Social Competence	The students are able develop solutions for		c topics orally with other stud ssues in a group.	ents or scientific	personal and
Autonomy	Students are able to a	analyze and solve q	uestions regarding solid partic	les independentl	у.
Workload in Hours	Independent Study Ti	me 110, Study Time	e in Lecture 70		
Credit points					
	CompulsorBonus	Form	Description		
Course achievement	Yes None	Written elaborati	on sechs Berichte (p Seiten	ro Versuch ein	Bericht) à 5-1
Examination	Written exam				
Examination duration and scale	90 minutes				
Assignment for the Following Curricula	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 Energy and Environmenta Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: 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 Environment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory Process Engineering: Core qualification: Compulsory				

Course L0434: Particle	Technology I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport
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	ourse L0435: Particle Technology I		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Stefan Heinrich		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

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

Courses				
Fitle Management Tutorial (L088 ntroduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busines	S		
ducational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 After taking this module, students know the important basics of many different areas in Business an Management, from Planning and Organisation to Marketing and Innovation, and also to Investment an Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines i 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 importar aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supplichain management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance state basics from accounting and costing and selected controlling methods. 			
Skills	 strategies etc.) and to carry out an Entrepreneration analyse Management goals and structed analyse organisational and staff structed apply methods for decision making und analyse production and procurement s analyse and apply basic methods of m select and apply basic methods from nerational apply basic methods from nerative structure stru	and staff structures of companies sion making under multiple objectives, under uncertainty and under risk procurement systems and Business information systems		
Personal Competence				
	Students are able to			
Social Competence	 work successfully in a team of student. to apply their knowledge from the lear report on the project to communicate appropriately and to cooperate respectfully with their fell 	ture to an entrepreneurship p	roject and w	rite a coheren
	Students are able to			
Autonomy	work in a team and to organize the teato write a report on their project.	m themselves		
Workload in Hours	Independent Study Time 110, Study Time in I	Lecture 70		
Credit points				
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration	several written exams during the semester			
	General Engineering Science (German progra Civil- and Environmental Engineering: Core q Civil- and Environmental Engineering: Specia Civil- and Environmental Engineering: Specia Civil- and Environmental Engineering: Specia Bioprocess Engineering: Core qualification: Cor Computer Science: Core qualification: Computer Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Cor Energy and Environmental Engineering: Core	ualification: Compulsory isation Civil Engineering: Electi isation Water and Environment isation Traffic and Mobility: Ele ompulsory Isory npulsory	ve Compulso : Elective Co	ny mpulsory

I	Consul Environment Chinese (Environment 7 consists), Consisting Electrical Environment
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	Construction Colored (Feelink and a 7 and also). Constallation Markeniael Feeline day
Following Curricula	
r onowing curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
1	Process Engineering: Core qualification: Compulsory

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

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

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Courses						
Title Process and Plant Engineeri	ng I (I 0095)		Typ Lecture	Hrs/wk 2	CP 2	
Process and Plant Engineeri	-		Recitation Section (large)	1	2	
Process and Plant Engineeri	ng I (L1214)		Recitation Section (small)	1	2	
Module Responsible		ki				
Admission Requirements	None					
Recommended	unit operation of ther	mal an dmechanical sep	aration processes			
Previous Knowledge	chemical reactor eing	ineering				
Educational Objectives	After taking part succ	essfully, students have	reached the following learning	results		
Professional Competence						
competence	students can:					
		blobal balanco oquatic	ns of chemical processes			
	-					
Knowledge	specify linear compor	ent equations of compl	ex chemical processes			
	explain linear regression and data reconcilliation problems					
	explain pfd-diagrams					
	students are capable of					
	- formulation of mass and energy balance equations and estimation of product streams					
	- estimation of component streams of chemical plants using linear component balance models					
Skills	- solution of data reconcilliation tasks					
	- conduction of process synthesis					
	- economic evaluation of processes and the estimation of production costs					
Personal Competence						
Social Competence						
Autonomy						
	. ,	me 124, Study Time in	ecture 56			
Credit points	o CompulsorBonus	Eorm	Description			
Course achievement		Form Subject theoretica practical work	Description and			
Examination	Written exam					
Examination duration and scale	120 Min lectures note	es and books				
			gram, 7 semester): Specialis	ation Proce	ss Engineerir	
	Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta					
	Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering					
	Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering					
	Compulsory Process Engineering:	Core qualification: Com	Nulson/			

Course L0095: Process	and Plant Engineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Mirko Skiborowski

Language	
Cycle	SoSe
Content	 Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression Data reconciliation and data validation Process Synthesis Decision levels Experimental process development Reactor synthesis Separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) A. Process safety S. Cost estimation of production plants Production costs, capital costs, economic evaluation A Synthesis Synthesis
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	Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004
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	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlun Blazek und Bergamann, Frankfurt, 2000
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
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	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
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	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
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	H.J. Lang, Chem. Eng. 54(10),117, 1947

F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process	rse 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			
Lecturer	. Mirko Skiborowski, Dr. Thomas Waluga			
Language	DE			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			

Course L1214: Process	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		
Lecturer	Prof. Mirko Skiborowski, Dr. Thomas Waluga		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
F itle Environmental Assessment	(1.0860)	Typ Lecture	Hrs/wk 2	CP 2
Environmental Assessment	, ,	Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements	None			
•	Fundamentals of inorganic/organi	c chemistry and biology		
Previous Knowledge				
	After taking part successfully, stu	dents have reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competent i dealing with different methods and instruments to assess environmental impacts. Besides the student are able to estimate the complexity of these environmental processes as well as uncertainties an difficulties with their measurement.			
Skills	assessment methods. Thereby environmental problems in a k Assessments independently and	It a suitable method for the respective they can develop suitable solutions for business context. They are able to ca d can apply the software programs O urse the students have the competence invironmental impacts.	managing rry out Life penLCA and	and mitigat e Cycle Imp d the databa
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical of 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 the future social responsibilities in their role as engineers.			
Autonomy		process and present a scientific topic inde vork. They can solve an environmental pro her publications.		
Workload in Hours	Independent Study Time 48, Stud	v Time in Lecture 42		
Credit points		, time in Lecture 72		
Course achievement				
Examination				
Examination duration and scale	1 hour written exam			
	Engineering: Compulsory General Engineering Science (Ge Elective Compulsory	rman program, 7 semester): Specialisatic erman program, 7 semester): Specialisati German program, 7 semester): Specialis	on Bioproce	ess Engineeri
Assignment for the Following Curricula	Energy and Environmental Engine General Engineering Science (Er Elective Compulsory General Engineering Science (En Engineering: Compulsory	infication: Elective Compulsory eering: Core qualification: Compulsory nglish program, 7 semester): Specialisati glish program, 7 semester): Specialisatio English program, 7 semester): Specialis	n Energy ar	nd Enviromei

Course L0860: Environ	mental Assessment		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	r. Anne Rödl, Dr. Christoph Hagen Balzer		
Language			
Cycle			
Content	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: Environ	mental Assessment
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
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 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.

Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structures Discrete Algebraic Structures		Lecture Recitation Section (small)	2 2	3 3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics from High School.			
Educational Objectives	After taking part successfully, stu	dents have reached the following learning	results	
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic structures including elementar combinatorial structures, monoids, groups, rings, fields, finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete algebraic structures.			
Personal Competence				
Social Competence	Students are able to solve specific	c problems alone or in a group and to prese	ent the resu	lts accordingly
	Students are able to acquire new knowledge from specific standard books and to associate the acquire knowledge to other classes.			
Workload in Hours	Independent Study Time 124, Stu	idy Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Compulsory Computer Science: Core qualificat General Engineering Science (I Compulsory Computational Science and Engin Orientierungsstudium: Core qualif	English program, 7 semester): Speciali eering: Core qualification: Compulsory		

Тур	Lecture		
Hrs/wk			
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Karl-Heinz Zimmermann		
Language	DE		
Cycle	WiSe		
Content			
Literature			

Course L0165: Discrete Algebraic Structures			
Тур	Typ 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		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses			Turn	Line /unic	CD
Title Computer Engineering (L03)	21)		Typ Lecture	Hrs/wk 3	CP 4
Computer Engineering (L03			Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk				
Admission	None				
Requirements					
Recommended Previous Knowledge	Basic knowledge in el	ectrical engineering			
-		essfully, students have	reached the following learning	results	
Professional					
Competence					
			he functionality of computing s to gates. The module includes		
	Introduction				
		logic: Gates, Boole	ean algebra, Boolean functi	ions, hardw	are synthes
	combinational r		austamatic hardwara dasian		
Knowledge	 Sequencial logic Technological f 		systematic hardware design		
		5	, subtraction, multiplication and		
		nory hierarchies, SRAM	ramming models, MIPS single-c , DRAM, caches	ycle architect	ure, pipelinir
	 Input/output: I/ 	/O from the perspecti	ve of the CPU, principles of p	passing data	, point-to-po
	connections, bu	JSSES			
			from the architect's perspect		
			tion of computer systems. The can be built based on a col		
	components. They ar	e able to distinguish b	between and to explain the dif	ferent abstra	
	today's computing sys	stems - from gates and	circuits up to complete process	sors.	
Skills	s After successful completion of the module, the students are able to judge the interdependencies				
	between a physical computer system and the software executed on it. In particular, they shal understand the consequences that the execution of software has on the hardware-centric abstraction				
	layers from the asse	mbly language down	to gates. This way, they will l	be enabled t	o evaluate t
	impact that these log feasible options.	w abstraction levels h	have on an entire system's pe	erformance a	ind to propo
_					
Personal Competence	Students are able to s	olvo cimilar probloms	along or in a group and to proce	ont the recult	s accordingly
Social Competence	Students are able to s	olve similar problems a	alone or in a group and to prese	ent the result	s accordingly
Autonomu		acquire new knowledg	e from specific literature and	to associate	this knowled
Autonomy	with other classes.				
Workload in Hours	Independent Study Tir	me 124, Study Time in	Lecture 56		
Credit points	6				
Course achievement	Compulsor₿onus	Form	Description		
	Yes 10 %	Excercises			
	Written exam				
Examination duration	90 minutes, contents	of course and labs			
and scale		Science (German p	rogram, 7 semester): Special	lisation Com	puter Sciend
and scale	General Engineering				
and scale	Compulsory	C			
and scale	Compulsory	Science (German prog	gram, 7 semester): Specialisati	ion Bioproces	s Engineerin
and scale	Compulsory General Engineering Compulsory General Engineering		gram, 7 semester): Specialisati ogram, 7 semester): Special		
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory	Science (German pr		isation Nava	I Architectu
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory	Science (German pr Science (German p	rogram, 7 semester): Special rogram, 7 semester): Specia	isation Nava	l Architectui il Engineerin
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering	Science (German pr Science (German p	ogram, 7 semester): Special	isation Nava	l Architectu
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering	Science (German pr Science (German p Science (German pro	rogram, 7 semester): Special rogram, 7 semester): Specia	isation Nava alisation Civ ation Electric	I Architectur II Engineerin al Engineerir
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory	Science (German pr Science (German p Science (German pro Science (German prog	rogram, 7 semester): Special rogram, 7 semester): Specia gram, 7 semester): Specialisa gram, 7 semester): Specialisati	isation Nava alisation Civ ation Electric	I Architectur II Engineerin al Engineerin al Engineerin
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Sompulsory General Engineering Compulsory General Engineering	Science (German pr Science (German pr Science (German pro Science (German prog Science (German prog	rogram, 7 semester): Special rogram, 7 semester): Specia gram, 7 semester): Specialisa gram, 7 semester): Specialisati ram, 7 semester): Specialisatic	isation Nava alisation Civ ation Electric ion Biomedic on Energy an	I Architectur il Engineerin al Engineerir al Engineerir d Enviroment
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Seneral Engineering Engineering: Compuls General Engineering	Science (German pr Science (German pr Science (German pro Science (German prog Science (German prog	rogram, 7 semester): Special rogram, 7 semester): Specia gram, 7 semester): Specialisa gram, 7 semester): Specialisati	isation Nava alisation Civ ation Electric ion Biomedic on Energy an	I Architectur il Engineerin al Engineerir al Engineerir d Enviroment
and scale	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Seneral Engineering Compulsory	Science (German pr Science (German pr Science (German pro Science (German prog Science (German prog ory Science (German prog	rogram, 7 semester): Special rogram, 7 semester): Specia gram, 7 semester): Specialisa gram, 7 semester): Specialisati ram, 7 semester): Specialisatic	isation Nava alisation Civ ation Electric ion Biomedic on Energy an sation Proces	I Architectu II Engineerir al Engineerir al Engineerir d Enviromen as Engineerir

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

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

Course L0324: Compute	urse 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		

Madula MOEE2: 0	biostoriontad Programming	Algorithms and Data S	tructur		
	bjectoriented Programming,	Algorithms and Data S	tructur	85	
Courses					
	g, Algorithms and Data Structures (L0131) g, Algorithms and Data Structures (L0132)	Typ Lecture Recitation Section (small)	Hrs/wk 4 1	CP 4 2	
Module Responsible	Prof. Rolf-Rainer Grigat				
Admission Requirements					
Recommended Previous Knowledge	This lecture requires proficiency in the German language. For further requirements please refer to the German description.				
Educational Objectives	After taking part successfully, students hav	ve reached the following learning i	results		
Professional Competence					
Knowledge	Students can explain the essentials of software design and the design of a class architecture with reference to existing class libraries and design patterns. Students can describe fundamental data structures of discrete mathematics and assess the complexity of important algorithms for sorting and searching.				
Skills	 Students are able to Design software using given design patterns and applying class hierarchies and polymorphism Carry out software development and tests using version management systems and Google Test Sort and search for data efficiently Assess the complexity of algorithms. 				
Personal Competence					
Social Competence	Students can work in teams and communic	ate in forums.			
Autonomy	Students are able to solve programming tasks such as LZW data compression using SVN Repository and Google Test independently and over a period of two to three weeks.				
Workload in Hours	Independent Study Time 110, Study Time i	n Lecture 70			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and scale	60 Minutes, Content of Lecture, exercises a	and material in StudIP			
	General Engineering Science (German Compulsory Computer Science: Core qualification: Com Electrical Engineering: Core qualification: C General Engineering Science (English p Compulsory Logistics and Mobility: Specialisation Engin Orientierungsstudium: Core qualification: E	pulsory compulsory program, 7 semester): Specialis eering Science: Elective Compulso	sation Con		

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

Course L0132: Objectoriented Programming, Algorithms and Data Structures		
Тур	Recitation Section (small)	
Hrs/wk		
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	

Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432		Lecture	3	4
Signals and Systems (L0433	3)	Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Requirements	Mathematics 1-3			
	The modul is an introduction to the theory of signa by the moduls Mathematik 1-3 is expected. Furth series, Fourier transform, Laplace transform) is us	ner experience with spectr		
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe a methods of signal and system theory. They are continuous-time and discrete-time signals and sy signals and systems mathematically in both time effects in time domain and image domain which signal to a discrete-time signal.	e able to apply the funda ystems. They can describe and image domain. In part n are caused by the trans	mental trai and analys icular, they sition of a o	nsformations se determinis understand t continuous-tin
Skills	The students are able to describe and analyse de using methods of signal and system theory. The important properties such as magnitude and pha the impact of LTI systems on the signal properties	ey can analyse and designed and designed and the set of	n basic systearity etc T	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant inform control their level of knowledge during the lectur clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Compulsory	n, 7 semester): Speciali n, 7 semester): Specialisa	sation Com ation Proce	nputer Scien ss Engineeri
	General Engineering Science (German program, Compulsory General Engineering Science (German program, Focus Biomechanics: Compulsory	•		5
	General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program,	7 semester): Specialisatic 7 semester): Specialisatic ory	on Mechanic on Mechanic	cal Engineerin
Assignment for the Following Curricula	General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Compu Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compuls General Engineering Science (English program,	7 semester): Specialisatic Ilsory	on Mechanic	cal Engineeri
,	Compulsory General Engineering Science (English progran Compulsory General Engineering Science (English program	n, 7 semester): Speciali	sation Com	puter Scien
	Compulsory	•		-

Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Biomechanics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Energy Systems: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Aircraft Systems Engineering: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Materials in Engineering Sciences: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Mechatronics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Theoretical Mechanical Engineering: Compulsory		
Computational Science and Engineering: Core qualification: Compulsory		
Mechatronics: Core qualification: Compulsory		
Technomathematics: Specialisation III. Engineering Science: Elective Compulsor	ry	

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

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

Courses				
Title		Тур	Hrs/wk	СР
Graph Theory and Optimiza	tion (L1046)	Lecture	2	3
Graph Theory and Optimiza	tion (L1047)	Recitation Section (s	mall) 2	3
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Requirements				
Recommended Previous Knowledge	J			
Educational Objectives	After taking part successfully, stude	nts have reached the following lea	rning results	
Professional Competence				
Knowledge	explain them using appropriat	I connections between these co with the help of examples.		2
Skills	studied in this course. More methods. • Students are able to discov studied in the course.	s in Graph Theory and Optimization over, they are capable of solving er and verify further logical con ents can develop and execute a su	g them by appl nections betwee	ying establish en the concer
Personal Competence	 Students are able to work tog 	ether in teams. They are capable t	o use mathemat	ics as a comm
Social Competence		inicate new concepts according to design examples to check and do		
Autonomy	can specify open questions pr	king their understanding of comp ecisely and know where to get hel ficient persistence to be able to v llems.	p in solving them	า.
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (Gen Compulsory Computer Science: Core qualification General Engineering Science (Eng	n: Compulsory glish program, 7 semester): Sp	ecialisation Cor	

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

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

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

Madula M0727. C				
Module M0727: S	tochastics			
Courses				
Title		Тур	Hrs/wk	СР
Stochastics (L0777)		Lecture	2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible Admission	Prof. Marko Lindner			
Requirements	None			
Recommended Previous Knowledge	 Calculus Discrete algebraic structures (combinatorics Propositional logic 	5)		
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				
Knowledge	Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (random variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can describe characteristic notions such as expected values, variance, standard deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on the chair rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms o notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision and computation problem for stochastic processes Students can also explain basic statistical detection and estimation techniques.			
Skills	Students can apply algorithms for solving decision problems, and they can justify whethe approximation techniques are good enough in various application contexts, i.e., students can deriv estimators and judge whether they are applicable or reliable.			
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their regular home work) in heterogeneously compose			
- Students are capable of checking their understanding of complex concepts on their specify open questions precisely and know where to get help in solving them.		own. They car		
Autonomy	 Students can put their knowledge in relation to the 	ne contents of other lectur	es.	
	 Students have developed sufficient persistence to manner on hard problems. 	o be able to work for longe	er periods in	a goal-orientec
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program Compulsory Computational Science and Engineering: Core qua Computational Science and Engineering: Core qua Logistics and Mobility: Specialisation Engineering S	i, 7 semester): Speciali lification: Compulsory lification: Compulsory	sation Com	

Course L0777: Stochas	tica
	Lecture
Hrs/wk	
CP	
	Independent Study Time 92, Study Time in Lecture 28
	Dr. Christian Seifert
Language	DE/EN
Cycle	
Content	 Foundations of probability theory Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detections Detectors Estimation rules and procedures Hypothesis and distribution tests Stochastic regression
Literature	 Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008 Stochastik für Informatiker, Dümbgen, L., Springer 2003 Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 Stochastik, Georgii, HO., deGruyter, 2009 Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001 Programmieren mit R, Ligges, U., Springer 2008

Course L0778: Stochas	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. Christian Seifert	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0624: A	utomata Theory and Formal L	anguages		
Courses				
Title Automata Theory and Form Automata Theory and Form		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
Module Responsible	Prof Tobias Knopp			
Admission	None			
Requirements	Participating students should be able to			
	- specify algorithms for simple data structur	es (such as, e.g., arrays) to solv	e computatio	onal problems
Recommended Previous Knowledge	- apply propositional logic and predicate log	ic for specifying and understand	ing mathem	atical proofs
	- apply the knowledge and skills taught in th	ne module Discrete Algebraic Str	uctures	
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	Students can explain syntax, semantics, and decision problems of propositional logic, and they are ab to give algorithms for solving decision problems. Students can show correspondences to Boolea algebra. Students can describe which application problems are hard to represent with proposition. logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, an 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, an 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 an nondeterministic finite automata and pushdown automata to Turing machines. Students can nam 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 formalism such as logic, automata, or grammars.			
Skills	Students analyze application problems in temporal logic formulas to represent them particular application problem, and they c problems to specific formulas. Students deterministic ones, or derive grammars fro work, and they can apply algorithms for the	n. They can evaluate which for an demonstrate the applicatior s can also transform nonde om automata and vice versa. T	malism is be of algorith terministic hey can sho	est suited for ms for decisio automata int ow how parser
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	Computational Science and Engineering: Co	ulsory am, 7 semester): Specialisation re qualification: Compulsory	·	
	Orientierungsstudium: Core qualification: Ele Technomathematics: Specialisation II. Inforr			

	ta Theory and Formal Languages
σνΤ	Lecture
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Tobias Knopp
Language	EN
Cycle	SoSe
Content	 Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF Predicate logic, unification, predicate logic resolution Temporal Logics (LTL, CTL) Deterministic finite automata, definition and construction Regular languages, closure properties, word problem, string matching Nondeterministic automata: Rabin-Scott transformation of nondeterministic into deterministic automata Epsilon automata, minimization of automata, elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states) Myhill-Nerode Theorem: Correctness of the minimization procedure, equivalence classes of strings induced by automata Pumping Lemma for regular languages: provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive enough to solve a word problem for some given language Regular expressions vs. finite automata: Equivalence of formalisms, systematic transformation of representations, reductions Pushdown automata and context-free grammars: Definition of pushdown automata, definition of context-free grammars, derivations, parse trees ambiguities, pumping lemma for context-free grammars, transformation of formalisms (fron pushdown automata to context-free grammars and back) Chomsky normal form CYK algorithm for deciding the word problem for context-free grammrs Deterministic pushdown automata Deterministic vs. nondeterministic pushdown automata: Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler Regular grammars Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars Outlook: Turing machines and linear bounded automata, representation of state transition systemarchy Mealy- and Moore automata: Automata with
Literature	 Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006 Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007

Course 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: E	mbedded Syste	ms				
Courses						
Title Embedded Systems (L0805) Embedded Systems (L0806)			Typ Lecture Recitation Section (s	Hrs/wk 3 mall) 1	CP 4 2	
Module Responsible	Prof. Heiko Falk					
Admission						
Recommended Previous Knowledge	Computer Engineering					
Educational Objectives	After taking part succe	essfully, students have rea	ached the following lea	rning results		
Professional Competence	Embedded systems can be defined as information processing systems embedded into enclosing products. This course teaches the foundations of such systems. In particular, it deals with ar introduction into these systems (notions, common characteristics) and their specification languages					
Knowledge	(models of computation, hierarchical automata, specification of distributed systems, task graphs, specification of real-time applications, translations between different models). Another part covers the hardware of embedded systems: Sonsors, A/D and D/A converters, real-time capable communication hardware, embedded processors, memories, energy dissipation, reconfigurable logic and actuators. The course also features an introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedded systems using hardware/software co-design (hardware/software partitioning, high-level transformations of specifications, energy-efficient realizations, compilers for embedded processors) is covered.					
	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize which relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall be able to compare different models o 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 so	olve similar problems alor	ne or in a group and to	present the resul	ts accordingly.	
	Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes.					
Workload in Hours	l Independent Study Time 124, Study Time in Lecture 56					
Credit points						
Course achievement	Compulsor B onus Yes 10 %	Form Subject theoretical practical work	Description and			
Examination	Written exam					
Examination duration and scale	90 minutes, contents of course and labs					
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Microelectronics and Microsystems: Specialisation Embedded Systems: Elective Compulsory					

Course L0805: Embedd	ed Systems			
-	-			
Тур	Lecture			
Hrs/wk	3			
СР	4			
Workload in Hours	ndependent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Heiko Falk			
Language	EN			
Cycle	SoSe			
Content	 Introduction Specifications and Modeling Embedded/Cyber-Physical Systems Hardware System Software Evaluation and Validation Mapping of Applications to Execution Platforms Optimization 			
Literature	 Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber-Physical Systems. 2nd Edition, Springer, 2012., Springer, 2012. 			

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

Module M0731: F	unctional Progr	amming				
		anning				
Courses						
Title			Тур	Hrs/wk	СР	
Functional Programming (LC	0624)		Lecture	2	2	
Functional Programming (LC			Recitation Section (large)	2	2	
Functional Programming (LC)626)		Recitation Section (small)	2	2	
Module Responsible						
Admission Requirements	None					
Recommended Previous Knowledge		at high-school level				
Educational Objectives	After taking part succe	ssfully, students hav	ve reached the following learning	results		
Professional Competence						
Knowledge	Students apply the principles, constructs, and simple design techniques of functional programming They demonstrate their ability to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and find errors in programs. They apply the fundamental data structures, data types, and type constructors. They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies.					
Skills	Students break a natural-language description down in parts amenable to a formal specification and develop a functional program in a structured way. They assess different language constructs, make conscious selections both at specification and implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program.					
Personal Competence						
Social Competence	Students practice peer programming with varying peers. They explain problems and solutions to the peer. They defend their programs orally. They communicate in English.					
Autonomy	I In programming labs, students learn under supervision (a.k.a. "Betreutes Programmieren") th mechanics of programming. In exercises, they develop solutions individually and independently, an receive feedback.					
Workload in Hours	Independent Study Tim	ne 96. Study Time in	Lecture 84			
Credit points						
Course achievement	CompulsorBonus	Form Excercises	Description			
Examination	Written exam					
Free and a still an advantation	90 min					
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory Data Science: Technical Complementary Course: Elective Compulsory Engineering Science: Specialisation Mechatronics: Elective Compulsory					

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

Course L0625: Functional Programming		
Тур	Recitation Section (large)	
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	 Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics 	
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.	

Course L0626: Function	nal Programming
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	 Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programming Idioms of Functional Programming Haskell Syntax and Semantics
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.

Module M0834: C	omputernetworks and I	Internet Security		
Courses				
Title Computer Networks and Inte Computer Networks and Inte		Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 5 1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of Computer Science			
Educational Objectives	After taking part successfully, stuc	lents have reached the following learning	results	
Professional Competence				
Knowledge	Students are able to explain important and common Internet protocols in detail and classify them, order to be able to analyse and develop networked systems in further studies and job.			
Skills	Students are able to analyse cor domains.	nmon Internet protocols and evaluate t	he use of th	nem in differe
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts learn and understand it.	out of high amount of professional know	ledge and ca	n independen
Workload in Hours	Independent Study Time 124, Stud	dy Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Electiv Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory e Engineering Science: Specialisation Mechatronics: Elective Compulsory a General Engineering Science (English program, 7 semester): Specialisation Computer Science: Electiv Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Electiv Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Electiv Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			

Тур	Lecture
Hrs/wk	
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
Content	In this class an introduction to computer networks with focus on the Internet and its security is give Basic functionality of complex protocols are introduced. Students learn to understand these and ident 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	 Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6. Auflag W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition Further literature is announced at the beginning of the lecture.

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

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
			L	-
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems i	n time and frequency domain, Lapla	ce transform	1
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in term of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain an implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain a vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequer response techniques They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks 		rules and frequen nuous-time ai	
Personal Competence				
Social Competence	Students can work in small groups to joi	intly solve technical problems, and e	experimental	ly validate the
	controller designs Students can obtain information from experiment guides) and use it when solv	n provided sources (lecture notes		
Autonomy	They can assess their knowledge in wee	kly on-line tests and thereby contro	l their learnii	ng progress.
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German p Bioprocess Engineering: Core qualificatio Computer Science: Specialisation Comp Data Science: Core qualification: Electiv Electrical Engineering: Core qualificatior Energy and Environmental Engineering: General Engineering Science (English Compulsory General Engineering Science (Engliss Compulsory	on: Compulsory utational Mathematics: Elective Con e Compulsory n: Compulsory Core qualification: Compulsory program, 7 semester): Specialisa	npulsory tion Electric alisation Civ	al Engineerin il Engineerin

	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
A set was such four the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Assignment for the	Focus Aircraft Systems Engineering: Compulsory
Following Curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core gualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory
	Process Engineering: Core qualification: Compulsory

urse 10654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	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 plots Root locus plots
Content	Root locus design of PID controllers Frequency response techniques Bode diagram
	 Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control
	Time delay systems
	 Root locus and frequency response of time delay systems Smith predictor
	Digital control
	 Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Software tools
	 Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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 Introductory Seminar Comp	uter Science I (12362)	Typ Seminar	Hrs/wk	СР 3
Introductory Seminar Comp		Seminar	2	3
	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge of Computer Science and	Mathematics at the Bach	elor's level.	
Educational Objectives	After taking part successfully, students have	ve reached the following le	earning results	
Professional Competence				
Knowledge	 The students are able to explicate a specific topic in the field describe complex issues, present different views and evaluate 	•		
Skills	The students are able to familiarize in a specific topic of Com realize a literature survey on the specific topic a presentation and give a sum up the presentation in 10-15 lir answer questions in the final discussion 	ecific topic and cite in a co lecture to a selected audi les,	prrect way,	
Personal Competence	The students are able to			
Social Competence	elaborate and introduce a topic for a	ture of the presentation w lience, and		
	The students are able to			
Autonomy	 define the task in question in an aut develop the necessary knowledge, use appropriate work equipment, ar guided by an instructor critically chemical structures and the structure of the struc	id		
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German prog Compulsory Computer Science: Core qualification: Com General Engineering Science (English prog Compulsory Computational Science and Engineering: C	pulsory ram, 7 semester): Specia	lisation Computer S	

Course L2362: Introductory Seminar Computer Science I	
Тур	Seminar
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	WiSe/SoSe
Content	
Literature	

Course L2361: Introduc	ourse L2361: Introductory Seminar Computer Science II	
Тур	Seminar	
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	WiSe/SoSe	
Content		
Literature		

Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (L	0417)	Lecture	2	3
Numerical Mathematics I (L	0418)	Recitation Section (small)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	 Mathematik I + II for Engineering S for Technomathematicians basic MATLAB knowledge 	tudents (german or english) or Ana	alysis & Line	ar Algebra I +
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	results	
Professional Competence				
	Students are able to			
Knowledge	 name numerical methods for int problems, nonlinear root finding pri- repeat convergence statements for explain aspects for the practical ex- and storage complexitx. 	oblems and to explain their core id the numerical methods,	eas,	
	Students are able to			
Skills	 implement, apply and compare nur justify the convergence behaviou solution algorithm, select and execute a suitable solut 	r of numerical methods with res	spect to the	e problem an
Personal Competence				
	Students are able to			
Social Competence	 work together in heterogeneously and background knowledge), exp practical aspects regarding the imp 	plain theoretical foundations and		
	Students are capable			
Autonomy	 to assess whether the supportinindividually or in a team, to assess their individual progess a 			
Workload in Hours	 Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement	None			
Examination				
Examination duration and scale	90 minutes			
	General Engineering Science (German	program, 7 semester): Speciali	sation Com	puter Science
	Compulsory General Engineering Science (German p	rogram, 7 semester): Specialisatio	on Mechanic	al Engineering
	Focus Materials in Engineering Sciences:	Compulsory		
	General Engineering Science (German p Compulsory	rogram, 7 semester): Specialisatio	on Biomedic	al Engineering
	General Engineering Science (German p	rogram, 7 semester): Specialisatic	on Mechanic	al Engineering
	Focus Biomechanics: Compulsory General Engineering Science (German p	rogram 7 comostor); Spocializatio	n Mochanic	al Engineering
	Focus Theoretical Mechanical Engineering Bioprocess Engineering: Specialisation A - Computer Science: Specialisation Comput Computer Science: Specialisation II. Math	: Compulsory General Bioprocess Engineering: E ational Mathematics: Elective Com	Elective Com pulsory	pulsory
	Data Science: Core qualification: Compuls	ory		-
	Electrical Engineering: Core qualification: Engineering Science: Core qualification: C			
Assignment for the	General Engineering Science (English pr Focus Theoretical Mechanical Engineering	ogram, 7 semester): Specialisatio : Elective Compulsory		
Following Curricula		aram / semesteri: (ore dualitication	nn. (umunie	orv

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mec	chanical Engineering,
Focus Biomechanics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mec	chanical Engineering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mec	chanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Bior	medical Engineering:
Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Electiv	ve Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compu	ulsory
Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Com	e Studies: Elective
Compulsory	
Process Engineering: Specialisation Process Engineering: Elective Compulsory	

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

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

Module M0791: C	omputer Architecture			
Courses				
Title Computer Architecture (L07	93)	Typ Lecture	Hrs/wk 2	CP 3
Computer Architecture (L07	94)	Project-/problem-based Learning	2	2
Computer Architecture (L18	64)		1	1
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge	Module "Computer Engineering"			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence				
Knowledge	This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies.			
Skills	The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to prese	nt 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 110, Study Time in Lectu	ıre 70		
Credit points	6			
Course achievement	CompulsorBonusFormNo15 %Subject theoretical a practical work	Description nd		
Examination	Written exam			
Examination duration and scale	90 minutes, contents of course and 4 attestations	from the PBL "Computer a	rchitecture"	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Computer Science: Specialisation I. Computer and Software Engineering: Elective Compulsory Aircraft Systems Engineering: Specialisation Avionic Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory Microelectronics and Microsystems: Specialisation Embedded Systems: Elective Compulsory			

Course L0793: Compute	er Architecture	
Тур	Lecture	
Hrs/wk		
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	 Introduction VHDL Basics Programming Models Realization of Elementary Data Types Dynamic Scheduling Branch Prediction Superscalar Machines Memory Hierarchies 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	 D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. 	

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

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

Courses				
Title		Тур	Hrs/wk	СР
Computability and Complexi	ity Theory (L0166)	Lecture	2	3
Computability and Complexi	ity Theory (L0167)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous Knowledge	Discrete Algebraic Structures, Automata	a Theory, Logic, and Formal Languag	ge Theory.	
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	The students known the important machine models of computability, the class of partial recursiv 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-Thur systems, Thue systems, semi-groups, and Post correspondence systems, Hilbert's 10-th problem, and the basic concepts of complexity theory.			
Skills	Students are able to investigate the computability of sets and functions and to analyze the complexit of computable functions.			
Personal Competence				
Social Competence	Students are able to solve specific problems alone or in a group and to present the results accordingly			
Autonomy	Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min			
	General Engineering Science (German p Compulsory Computer Science: Core qualification: C Data Science: Core qualification: Electiv General Engineering Science (English p Compulsory Computational Science and Engineering Technomathematics: Specialisation II. Ir	ompulsory e Compulsory rogram, 7 semester): Specialisation : Specialisation I. Computer Science	Computer S	cience: Electiv

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	urse 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 M0971: O	perating Systems			
Courses				
Title		Тур	Hrs/wk	СР
Operating Systems (L1153)		Lecture	2	3
Operating Systems (L1154)		Recitation Section (small)	2	3
Module Responsible	Prof. Volker Turau			
Admission Requirements	None			
Recommended Previous Knowledge	 Object-oriented programming, algorithms, and data structures Procedural programming Experience in using tools related to operating systems such as editors, linkers, compilers Experience in using C-libraries 			
Educational Objectives	After taking part successfully, students have	reached the following learning	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, conditiona variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms.			
Skills	Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judge the efficiency of a scheduling algorithm for a given scheduling task in a given environment.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
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 Computer Science: Specialisation I. Computer and Software Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory			

ourse L1153: Operating Systems		
re 28		
son International Edition baum, Pearson Studium		

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

Module M0732: S	oftware Enginee	ring			
Courses					
Title Software Engineering (L062 Software Engineering (L062			Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Sibylle Schupp				
Admission Requirements					
Recommended Previous Knowledge	 Procedural progra 	and formal languages amming or Functional pr rogramming, algorithms			
Educational Objectives	After taking part succes	sfully, students have rea	ached the following learning	results	
Professional Competence					
Knowledge	Students explain the phases of the software life cycle, describe the fundamental terminology and concepts of software engineering, and paraphrase the principles of structured software development. They give examples of software-engineering tasks of existing large-scale systems. They write test cases for different test strategies and devise specifications or models using different notations, and critique both. They explain simple design patterns and the major activities in requirements analysis, maintenance, and project planning.				
Skills	For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. They choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and find errors at different levels. They apply and modify non-executable artifacts. They integrate components based on interface specifications.				
Personal Competence					
	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	e 124, Study Time in Leo	cture 56		
Credit points	6				
Course achievement	CompulsorBonus Form Description				
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the Following Curricula					

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

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

Courses				
Fitle Management Tutorial (L088 ntroduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk CP 2 3 3 3	
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busin	ess		
ducational Objectives	After taking part successfully, students hav	e reached the following learning	results	
Professional Competence				
Knowledge	 After taking this module, students know the Management, from Planning and Organisat Controlling. In particular they are able to explain the differences between Management and to name important explain the most important aspects aspects of entreprneurial projects describe and explain basic business chain management, organization and innovation management and market explain the relevance of planning multiple objectives and uncertaint Finance state basics from accounting and cost 	on to Marketing and Innovation, Economics and Management a definitions from the field of Mana of and goals in Management and functions as production, procure d human ressource management ing and decision making in Busines y, and explain some basic me sting and selected controlling met	and also to Investm agement d name the most in ment and sourcing , information mana s, esp. in situation ethods from math	nent an plines i mportan g, suppl gement ns unde ematica
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 analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse 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 		ble to	
Personal Competence				
-	Students are able to			
Social Competence	 work successfully in a team of studer to apply their knowledge from the l report on the project to communicate appropriately and to cooperate respectfully with their from the statement of the	ecture to an entrepreneurship p	roject and write a o	coheren
	Students are able to			
Autonomy	work in a team and to organize the team themselvesto write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time ii	1 Lecture 70		
Credit points				
Course achievement				
Examination	Subject theoretical and practical work			
Examination duration	several written exams during the semester			
	General Engineering Science (German prog Civil- and Environmental Engineering: Core Civil- and Environmental Engineering: Spec Civil- and Environmental Engineering: Spec Civil- and Environmental Engineering: Spec Bioprocess Engineering: Core qualification: Computer Science: Core qualification: Comp Data Science: Core qualification: Compulso Electrical Engineering: Core qualification: C Energy and Environmental Engineering: Con	qualification: Compulsory alisation Civil Engineering: Electi alisation Water and Environment alisation Traffic and Mobility: Ele Compulsory oulsory 7y ompulsory	ve Compulsory : Elective Compulso	ory

1	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	
5	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
1	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
ı	Process Engineering: Core qualification: Compulsory

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

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

Module M1269: L	ab Cyber-Physical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Lab Cyber-Physical Systems	s (L1740)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
	Cyber-Physical Systems (CPS) are tightly int A/D and D/A converters, and actors. Due sensors, processors and actors are comm specification approaches for CPS - in contrast Based on practical experiments using rob	to their particular applicatio non. Accordingly, there is a to classical software engineer	n areas, hig large varie ing approacl	phly specialized ety of different nes.
Knowledge	modelling of CPS are taught. The lab introduces into the area (basic notions, characteristical properties and their specification techniques (models of computation, hierarchical automata, data flow models petri nets, imperative approaches). Since CPS frequently perform control tasks, the lab's experiments will base on simple control applications. The experiments will use state-of-the-art industria 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 a	lone or in a group and to prese	ent the resul	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 I	_ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale	Execution and documentation of all lab exper	iments		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Technical Complementary Course: Elective Compulsory			

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

Courses				
Title		Тур	Hrs/wk	СР
Mathematical Statistics (L13 Mathematical Statistics (L13		Lecture Recitation Section (small)	3 1	4 2
	·	Recitation Section (Small)	1	Z
	Prof. Natalie Neumeyer			
Admission Requirements	None			
Recommended	Mathematical Stochastics			
Previous Knowledge	Measure Theory and Stochastics			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 Students can describe basic concepts Maximum-Likelihood methods for cor optimal tests for parametric probabili application to estimation and test prob and test families. They are able to expl Students can discuss logical connec illustrating these connections with the They know proof strategies and can repl 	nstruction of estimators, optin ty distributions, sufficiency a lems, tests in normal distributi ain them using appropriate exi- tions between these concep help of examples.	mal unfalsi nd complet on and cont amples.	fied estimator eness and the
Skills	 Students can model problems in Mathematical Statistics with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concept studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able t critically evaluate the results. 			
Personal Competence				
Social Competence	 Students are able to work together in t language. In doing so, they can communicate no partners. Moreover, they can design e peers. 	ew concepts according to the	needs of th	neir cooperatir
Autonomy	 Students are capable of checking their understanding of complex concepts on their own. Th can specify open questions precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goor oriented manner on hard problems. 			
	Independent Study Time 124, Study Time in L	ecture 56		
Credit points Course achievement				
Examination				
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective			

Course L1339: Mathem	atical 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	 Substitution and Maximum-Likelihood methods for construction of estimators Optimal unfalsified estimators Optimal tests for parametric probability distributions (Neymann-Pearson theory) Sufficiency and completeness and their application to estimation and test problems Tests in normal distribution (e.g. Student's test) Confidence domains and test families
Literature	 V. K. Rohatgi and A. K. Ehsanes Saleh (2001). An introduction to probability and statistics. Wiley. L. Wasserman (2010). All of statistics : A concise course in statistical inference. Springer. H. Witting (1985). Mathematische Statistik: Parametrische Verfahren bei festem Stichprobenumfang. Teubner.

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: M	lechanical Engineering: Desi	an		
-		5		
Courses				
Title	Тур	Hrs/wk	СР	
Embodiment Design and 3D	D-CAD (L0268)	Lecture Project-/problem-based	2	1
Mechanical Design Project I	(L0695)	Learning	3	2
Mechanical Design Project I	I (L0592)	Project-/problem-based Learning	3	2
Team Project Design Metho	dology (L0267)	Project-/problem-based Learning	2	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Knowledge	 After passing the module, students are able to: explain design guidelines for machinery parts e.g. considering load situation, materials and manufacturing requirements, describe basics of 3D CAD, explain basics methods of engineering designing. 			
Skills	After passing the module, students are able to: • independently create sketches, technical drawings and documentations e.g. using 3D CAD, • design components based on design guidelines autonomously, • dimension (calculate) used components, • use methods to design and solve engineering design tasks systamtically and solution-oriented, • apply creativity techniques in teams.			
Personal Competence				
	After passing the module, students are at	ole to:		
Social Competence	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 			
	Students are able			
Autonomy	• to estimate their level of knowledge using activating methods within the lectures (e.g. with			

Workload in Hours	Independen	<u>t Study Tir</u>	ne 40, Study Time in Lect	ure 140
Credit points	6			
	Compulso	r₿onus	Form	Description
	Yes	None	Written elaboration	Teamprojekt Konstruktionsmethodik
Course achievement	Yes	None	Written elaboration	Konstruktionsprojekt 1
	Yes	None	Written elaboration	Konstruktionsprojekt 2
	Yes	None	Written elaboration	3D-CAD-Praktikum
Examination		m		
Examination duration and scale	180			
Following Curricula	Compulsory General Eng Compulsory General Eng Engineering Energy and General Eng Compulsory General Eng Compulsory General Eng Mechanical Mechatronic	gineering S : Compulso Environme gineering S gineering S : Compulso Engineering S: Core qu	Science (German program science (German program bry ental Engineering: Core qu Science (English program Science (English program Science (English program	n, 7 semester): Specialisation Mechanical Engineering n, 7 semester): Specialisation Biomedical Engineering , 7 semester): Specialisation Energy and Enviromenta npulsory

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

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

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

Course L0267: Team Pr	oject Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	 Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

Module M0933: F	undamentals of Materials Science)		
Courses				
Title Fundamentals of Materials S Fundamentals of Materials S Composites) (L0506)	Science I (L1085) Science II (Advanced Ceramic Materials, Polymers and cs of Materials Science (L1095)	Typ Lecture Lecture Lecture	Hrs/wk 2 2 2	CP 2 2 2
Module Responsible		Lecture	L	2
Admission Requirements				
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathema	atics		
Educational Objectives	After taking part successfully, students have reac	hed the following le	earning results	
Professional Competence				
Knowledge	The students have acquired a fundamental kno describe this knowledge comprehensively. Fundar of atomic structure, microstructure, phase diagra properties. The students know about the key aspe identify relevant approaches for characterizing phenomena back to the underlying physical and c	mental knowledge ms, phase transfor ects of characteriza specific properties	here means specifi mations, corrosion ation methods for ma . They are able to	cally the issue and mechanica aterials and ca
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 a 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 of the material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Course achievement				
Examination Examination duration	Written exam 180 min			
and scale	General Engineering Science (German program,	7	sislingtion Marchania	
Assignment for the Following Curricula	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Engineering: Compulsory Energy and Environmental Engineering: Core qual General Engineering Science (English program,	7 semester): Spe n, 7 semester): Spec ification: Compulse 7 semester): Spec 7 semester): Spec n, 7 semester): Spec 5 semester): Spec	cialisation Biomedia Specialisation Nava ialisation Energy ar ory cialisation Mechanic cialisation Biomedia Specialisation Nava ialisation Energy ar	cal Engineering al Architecture ad Enviromenta cal Engineering cal Engineering al Architecture
	Mechanical Engineering: Core qualification: Comp Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineerin	ulsory y		

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

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

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

Courses				
Title	Тур		Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)		ture itation Section (large)	3 2	4 2
			-	-
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechanics and thermodynamics.			
ducational Objectives	After taking part successfully, students have reached the	he following learning r	esults	
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineerir and physics of fluids. Students can scientifically outline the rationale of flow physics usir mathematical models and are familiar with methods for the performance analysis and the prediciton fluid engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculation for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
	The students are able to discuss problems and jointly d	levelop solution strate	gies.	
Social Competence				
Autonomy	The students are able to develop solution strategies fo analyse results.	or complex problems s	self-consiste	ent and crtica
Workload in Hours)		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectur 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			

ourse L0454: Fluid Me	echanics		
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	 Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows 		
Literature	 Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004 		

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: Multibody System		(Kinetics II,	Oscillations,	Analytical	Mechanics,
Courses					
Title Mechanics IV (Kinetics II, Os	cillations, Analytical Mech	nanics, Multibody Systems	Typ	Hrs/wk	СР 3
(L1137) Mechanics IV (Kinetics II, Os (L1138)	cillations, Analytical Mech	nanics, Multibody Systems) Recitation Section	(small) 2	2
Mechanics IV (Kinetics II, Os (L1139)	cillations, Analytical Mech	nanics, Multibody Systems) Recitation Section	(large) 1	1
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	Mathematics I-III and M	lechanics I-III			
Educational Objectives	After taking part succe	ssfully, students have re	eached the following l	earning results	
Professional Competence	The students can				
Knowledge	 describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge. 				
Skills	 The students can explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic methods to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. 				
		in groups and support of of determining their ow those.			rganize their time
Workload in Hours	Independent Study Tin	ne 96, Study Time in Leo	ture 84		
Credit points					
Course achievement	CompulsorBonus No 20 %	Form Midterm	Description Wird nur im Sos	Se angeboten	
Examination				-	
Examination duration and scale	120 min				
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory General Engineering Compulsory Energy Systems: Tech General Engineering S Compulsory General Engineering Compulsory Mechanical Engineerin Mechatronics: Core qu Naval Architecture: Co Technomathematics: S	icience (German progra icience (German progra Science (German progra nical Complementary Co Science (English progra Science (English progra Science (English prog g: Core qualification: Co alification: Compulsory re qualification: Compuls re qualification III. Enginee al Engineering: Techn	am, 7 semester): Spe gram, 7 semester): urse Core Studies: Ele m, 7 semester): Spe m, 7 semester): Spe ram, 7 semester): mpulsory sory ering Science: Elective	cialisation Biomer Specialisation Na ective Compulsory cialisation Mechar cialisation Biomer Specialisation Na	dical Engineering: aval Architecture: nical Engineering: dical Engineering: aval Architecture:

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	
Content	 Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab 	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).	

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

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

Courses						
Fitle Practical Course: Measurem Measurement Technology for Measurement Technology for	or Mechanical Engineering	g (L1116)		Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	CP 2 3 1
Module Responsible						
Admission						
Requirements						
Recommended Previous Knowledge	Basic knowledge of phy	ysics, chemistry and	electrica	al engineering		
ducational Objectives	After taking part succe	essfully, students hav	ve reache	ed the following learning	results	
Professional Competence	Students are able to na			mentals of the Measurer		
Knowledge	and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems). They can outline the most important measuring methods for different kinds of quantities to b maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency). They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Ga Chromatography)					
Skills	Students can select suitable measuring methods to given problems and can use refering measuremer devices in practice. The students are able to orally explain issues in the subject area of measurement technology an solution approaches as well as place the issues into the right context and application area.					
Personal Competence						
Social Competence	Students can arrive at work results in groups and document them in a common report.					
Autonomy	Students are able to familiarize themselves with new measurement technologies.					
	Independent Study Tim	ne 110, Study Time i	n Lectur	e 70		
Credit points	-	Earm		Description		
Course achievement	Compulsor B onus Yes None	Form Subject theoreti practical work	cal an	Description		
	Written exam					
Examination duration and scale	105 minutes					
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulso Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory	Science (German pro ineering: Core qualit intal Engineering: Co specialisation Mecha specialisation Mecha specialisation Biomer Science (English pro Science (English pro Science (English pro Science (English pro Science (English pro Science (English pro	ogram, 7 ogram, 7 fication: (ore qualif tronics: C nical Eng dical Eng gram, 7 ogram, 7 ogram, 7 ogram, 7 sogram, 7 sogram, 7	ication: Compulsory Compulsory	on Biomedia n Energy ar n Energy ar on Mechanic on Biomedia Mechatronics on Mechanic	al Engineeri ad Enviromer ad Enviromer al Engineeri al Engineeri 5: Compulsor al Engineeri

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

urse L1116: Measure	ement Technology for Mechanical Engineering		
Тур	Lecture		
Hrs/wk	2		
СР	3		
	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Thorsten Kern, Dennis Kähler		
Language Cycle			
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		
Content	2.4 Oscilloscope		
	2.5 Analog-to-Digital Conversion		
	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		
	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer 2006, ISBN: 978-3-540-34055-3.		
Literature	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978 3486217940.		

ourse L1118: Measurement Technology for Mechanical Engineering				
Recitation Section (large)				
1				
1				
Independent Study Time 16, Study Time in Lecture 14				
Prof. Thorsten Kern				
EN				
WiSe				
See interlocking course				
See interlocking course				

Module M0865: F	undamentals of Proc	luction and Quality Manag	jement		
Courses					
Title Production Process Organiza Quality Management (L0926		Typ Lecture Lecture	Hrs/wk 2 2	CP 3 3	
Module Responsible	Prof. Hermann Lödding				
Admission Requirements	None				
Recommended Previous Knowledge	None				
Educational Objectives	After taking part successfully,	students have reached the following le	earning results		
Professional Competence					
Knowledge	Students are able to explain the contents of the lecture of the module.				
	Students are able to apply the methods and models in the module to industrial problems.				
Personal Competence					
Social Competence	1				
Autonomy	I				
	Independent Study Time 124,	Study Time in Lecture 56			
Credit points					
Course achievement					
	Written exam				
Examination duration and scale	180 Minuten				
	Elective Compulsory General Engineering Science Focus Aircraft Systems Engine General Engineering Science Focus Product Development a Engineering Science: Core qua General Engineering Science Elective Compulsory General Engineering Science Logistics and Mobility: Special	(German program, 7 semester): Spec nd Production: Compulsory	cialisation Mechanic cialisation Mechanic cialisation Mechanic ualification: Compuls	cal Engineering cal Engineering cal Engineering	

Course L0925: Product	ion Process Organization		
Тур	Lecture		
Hrs/wk	2		
CP			
	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Hermann Lödding		
Language			
Cycle			
	(A) Introduction		
	(B) Product planning		
	(C) Process planning		
	(D) Procurement		
Content	(E) Manufacturing		
	(F) Production planning and control (PPC)		
	(G) Distribution		
	(H) Cooperation		
	Wiendahl, HP.: Betriebsorganisation für Ingenieure		
Literature	Vorlesungsskript		

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

Module M0934: A	dvanced Materials				
Courses					
Title		Тур	Hrs/wk	СР	
Advanced Materials Charac	terization (L1087)	Lecture	2	2	
Advanced Materials Design		Lecture	2	2	
Advanced Materials Design	(L1092)	Recitation Section	n (large) 2	2	
Module Responsible					
Admission Requirements					
Recommended Previous Knowledge	Fundamentals of Materials Science ((I and II)			
Educational Objectives	After taking part successfully, stude	nts have reached the following	learning results		
Professional					
Competence					
Knowledge	The students will be able to explain the properties of advanced materials along with their application in technology, in particular metallic, ceramic, polymeric, semiconductor, modern composite material (biomaterials) and nanomaterials.				
Skills	The students will be able to select material configurations according to the technical needs and, i necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables ther to select optimum materials combinations depending on the technical applications.				
Personal Competence					
	The students are able to present solutions to specialists and to develop ideas further.				
Social Competence					
	The students are able to				
Autonomy	 assess their own strengths and weaknesses. define tasks independently. 				
Workload in Hours	Independent Study Time 96, Study T	Time in Lecture 84			
Credit points					
Course achievement					
	Written exam				
Examination duration and scale	90 min				
	General Engineering Science (Gern	nan program, 7 semester): Spe	cialisation Mechani	cal Engineerir	
	Elective Compulsory				
	General Engineering Science (Gern	nan program, 7 semester): Spe	cialisation Mechani	cal Engineerii	
Assignment for the	Focus Biomechanics: Compulsory	nan program 7 semester). Spe	cialisation Mechani	cal Engineeri	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory				
	Data Science: Specialisation Materials Science: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering				
	Elective Compulsory				
	Mechanical Engineering: Core qualif	ication: Elective Compulsory			

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

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

Module M0610: E	lectrical Machines and Actuato	rs		
Courses				
Title Electrical Machines and Actor Electrical Machines and Actor		Typ Lecture Recitation Section (large)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof. Thorsten Kern			
Admission				
Requirements				
Recommended Previous Knowledge	Basics of mathematics, in particular complexe numbers, integrals, differentials Basics of electrical engineering and mechanical engineering			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
	Students can to draw and explain the basic p	principles of electric and magne	etic fields.	
Knowledge	They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the majo parameters of the energy efficiency of the whole system from the power grid to the driven engine.			
	Students arw able to calculate two-dimension circuits with air gap. For this they apply the u			
Skills	They can calulate the operational performance of electric machines from their given characteristic dat and selected quantities and characteristic curves. They apply the usual equivalent circuits an graphical methods.			
Personal Competence Social Competence				
Autonomy	Students are able independently to calculate to analyse independently the operational per and theycan calculate thereof selected quant	formance of electric machines	from the cha	
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and scale	Design of four machines and actuators, revie	w of design files		
Assignment for the Following Curricula	General Engineering Science (German progr Engineering: Compulsory General Engineering Science (German progr Elective Compulsory General Engineering Science (German progr Elective Compulsory General Engineering Science (German progr Focus Energy Systems: Compulsory General Engineering Science (German progr Focus Mechatronics: Compulsory General Engineering Science (German progr Focus Theoretical Mechanical Engineering: El Digital Mechanical Engineering: Core qualificat Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English progr Elective Compulsory Computational Science and Engineering: Spe Logistics and Mobility: Specialisation Engineer Mechanical Engineering: Core qualification: E Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engine	gram, 7 semester): Specialisa ram, 7 semester): Specialisati ram, 7 semester): Specialisati ram, 7 semester): Specialisati ram, 7 semester): Specialisati ective Compulsory ation: Compulsory qualification: Compulsory ram, 7 semester): Specialisatio am, 7 semester): Specialisatio am, 7 semester): Specialisatio cialisation Engineering Science ring Science: Elective Compuls lective Compulsory	tion Electric on Mechanic on Mechanic on Mechanic on Mechanic tion Electric n Energy an on Mechanic s: Elective C ory	al Engineerin al Engineerin al Engineerin al Engineerin al Engineerin d Engineerin d Enviroment al Engineerin

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

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

Focus Biomechanics

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

Module M0597: A	dvanced Mechanical Engineer	ring Design				
Courses						
Title Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin	neering Design II (L0265) neering Design I (L0262)	Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 2 2 2	CP 2 1 2 1		
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous Knowledge	Mechanics	Fundamentals of Materials Science				
Educational Objectives	After taking part successfully, students have	e reached the following learning	results			
Professional Competence						
Knowledge	 After passing the module, students are able to: explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples of complex machine elements, indicate the background of dimensioning calculations. 					
Skills	 After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. 					
Personal Competence	Students are able to discuss tech	nical information in the lectu	re supported	d by activating		
Autonomy	 Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood conten e.g. by using the video recordings of the lectures. 					
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112				
Credit points	6					
Course achievement	None					
	Written exam					
Examination duration and scale	1120					
	General Engineering Science (German pro Focus Aircraft Systems Engineering: Compu General Engineering Science (German pro Focus Materials in Engineering Sciences: Co General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Focus Product Development and Production General Engineering Science (German pro Focus Theoretical Mechanical Engineering: G General Engineering Science (German pro Focus Biomechanics: Compulsory General Engineering Science (German pro Focus Biomechanics: Compulsory General Engineering Science (German pro Focus Energy Systems: Compulsory	lsory gram, 7 semester): Specialisat mpulsory gram, 7 semester): Specialisat gram, 7 semester): Specialisat : Compulsory gram, 7 semester): Specialisat Compulsory gram, 7 semester): Specialisat	ion Mechanic ion Mechanic ion Mechanic ion Mechanic	cal Engineering cal Engineering cal Engineering cal Engineering cal Engineering		

Assignment for the Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, **Following Curricula** Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Course L0264: Advance	ed Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
	Advanced Mechanical Engineering Design I & II
Content	Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Clutches & brakes • Belt & chain drives • Sliding bearings • Clutches & brakes • Silding bearings • Clutches & brakes • Belt & chain drives • Silding bearings • Clutches & brakes • Belt & chain drives • Silding bearings • Clutches & brakes • Belt & chain drives • Gear drives • Sliding bearings • Clutches & brakes • Belt & chain drives • Gear drives • Sliding bearings • Clutches & brakes • Belt & chain drives • Gear drives • Sliding bearings • Clutchain drives • Sliding bearings • Calculations of hydrostatic systems (fluidics)
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

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

urse L0262: Advance	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II Lecture • 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 • Linear rolling bearings • Linear rolling bearings • 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 • Gear drives • Crank gears • Silding bearings
Literature	 Calculations of hydrostatic systems (fluidics) 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg aktuelle Auflage.

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

Module M1277: M	IED I: Introduction to Anatomy	/		
Courses				
Title Introduction to Anatomy (LC	384)	Typ Lecture	Hrs/wk 2	СР 3
Module Responsible	Prof. Udo Schumacher			
Admission Requirements				
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students have	e reached the following l	earning results	
Professional Competence				
Knowledge	The students can describe basal structures system. The students can describe the basic macros		5	musculoskelet
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 current professional level.	discussions in biomed	ical research and	medicine on
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversation on the topic and acquire the relevant knowledge themselves.			
Workload in Hours	Independent Study Time 62, Study Time in L	_ecture 28		
Credit points	3			
Course achievement	None			
Examination				
Examination duration and scale	90 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective 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 Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Focus Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsor Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Electi Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent St	udy Time 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lar	nge
Language	DE	
Cycle	SoSe	
	General Anato	omy
	1 st week:	The Eucaryote Cell
	2 nd week:	The Tissues
	3 rd week:	Cell Cycle, Basics in Development
	4 th week:	Musculoskeletal System
	5 th week:	Cardiovascular System
	6 th week:	Respiratory System
Contont	7 th week:	Genito-urinary System
Content	8 th week:	Immune system
	9 th week:	Digestive System I
	10 th week:	Digestive System II
	11 th week:	Endocrine System
	12 th week:	Nervous System
	13 th week:	Exam
		hael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016

Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L043)		Lecture	3	4 2
Signals and Systems (L043	1	Recitation Section (small)	Z	Z
Module Responsible				
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of sign by the moduls Mathematik 1-3 is expected. Fur- series, Fourier transform, Laplace transform) is u	her experience with spectr		
ducational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe methods of signal and system theory. They ar continuous-time and discrete-time signals and s signals and systems mathematically in both time effects in time domain and image domain whic signal to a discrete-time signal.	e able to apply the funda systems. They can describe and image domain. In part ch are caused by the trans	mental trai and analys cicular, they sition of a	nsformations se determinis understand t continuous-tir
Skills	The students are able to describe and analyse of using methods of signal and system theory. The important properties such as magnitude and phe the impact of LTI systems on the signal properties	ey can analyse and desig ase response, stability, line	n basic sys arity etc 1	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant infor control their level of knowledge during the lectu clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
	General Engineering Science (German program Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory	ım, 7 semester): Speciali	sation Con	nputer Scien
	General Engineering Science (German program Compulsory			-
	General Engineering Science (German program Compulsory General Engineering Science (German program	· · ·		5
	Focus Biomechanics: Compulsory General Engineering Science (German program Focus Energy Systems: Compulsory	, 7 semester): Specialisatio	on Mechanic	al Engineerii
	General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Compul	, 7 semester): Specialisatio		5
	General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program	, 7 semester): Specialisatio		5
A	Focus Theoretical Mechanical Engineering: Comp Computer Science: Core qualification: Compulsor Electrical Engineering: Core qualification: Compu	ulsory V		
Following Curricula	General Engineering Science (English program Compulsory	i, 7 semester): Specialisat		
	General Engineering Science (English progra Compulsory General Engineering Science (English prograr			
		ii, 7 semester). Specialise		55 Engineen
	Compulsory General Engineering Science (English program, Compulsory	· · ·		5

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

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

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

Display Typ Hrs/wk CP Module Responsible [Prof. Unich Carl Admission Requirements None Admission None	Courses				
Module Responsibile Prof. Ulrich Carl Admission Requirements Ione Recommended Provious Knowledge Ione Educational Objectives After taking part successfully, students have reached the following learning results Profosional Competence The tay The students can distinguish different types of currently used equipment with respect to its use radiation therapy. The students can acplain treatment plans used in radiation therapy in interdisciplinary contexts (e. surgery, internal medicine). The students can acplain treatment plans used in radiation therapy in interdisciplinary contexts (e. surgery, internal medicine). Diagnostics Knowledge The students can acplain the diagnostic as well as therapeutic use of imaging techniques, as well as therapeutic use of imaging techniques, as well as the technical basis for those techniques. The students can acplain the diagnostic as well as therapeutic use of imaging techniques. The students can acplain the influence of technical errors on the imaging techniques. The students can distinguish curative and palliative situations and motivate why they came to th conclusion. The students can distinguish different kinds of radiation, can choose the best one depending on the adiation biological aspects. The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the ene	Title	d Radiation Therapy (10383)		-	
Admission Requirements None Recommended Previous Knowledge None Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence The students can distinguish different types of currently used equipment with respect to its use radiation therapy. The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e. surgery, internal medicine). The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e. surgery, internal medicine). The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e. surgery, internal medicine). The students can allustrate the technical base concepts of projection radiography, includir angiography and mammography, as well as sectional imaging techniques (CT, MRT, US). The students can coxplain the diagnostic as well as therapeutic use of imaging techniques, as well as the technical basis for those techniques. The students can chose the right conclusions based on the imaging techniques. The students can distinguish curative and pallitive situations and motivate why they came to th conclusion. The students can distinguish different kinds of radiation, can chose the best one depending on the situation (location of the turnor) and choose the energy needed in that situation (irradiation planning). Social Competence The students can suggest solutions for repairs of imaging instrumentation after having done err analyses.			Lecture	2	5
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Credit points 3	Autonomy				competently
	Workload in Hours	Independent Study Time 62, Study Tim	e in Lecture 28		
	Credit points	3			-

Examination	Written exam
Examination duration and scale	90 minutes
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Following Curricula	Compulsory
-	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Тур	Lecture
Hrs/wk	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 medical imaging, interventional radiology and radiation therapy/radiation oncology. It 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) a therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big un which determine a predefined sequence in their respective departments
Literature	 "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 "Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschien 08.12.2009 ISBN: 978-3-437-47501-6 "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulu 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 "Praxismanual Strahlentherapie" von Stöver / Feyer – 1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000

Module M1333: B	IO I: Implants and Fracture H	lealing		
Courses				
Title Implants and Fracture Heali	ng (L0376)	Typ Lecture	Hrs/wk 2	CP 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
	It is recommended to participate in "Ir Fracture Healing".	troduction into Anatomie" b	efore attending	"Implants and
Educational Objectives	After taking part successfully, students ha	ve reached the following learn	ning results	
Professional Competence				
KNOWIEOOE	The students can describe the different was The students can name different treatme morphologies.			
Skills	The students can determine the forces under specific assumptions.	acting within the human boo	dy under quasi-s	tatic situations
Personal Competence				
Social Competence	The students can, in groups, solve basic n	umerical modeling tasks for th	ne calculation of i	internal forces.
Autonomy	The students can, in groups, solve basic n	umerical modeling tasks for th	ne calculation of i	internal forces.
Workload in Hours	Independent Study Time 62, Study Time in	n Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German pr Focus Biomechanics: Compulsory General Engineering Science (German pr Compulsory Engineering Science: Specialisation Biome General Engineering Science (English pr Compulsory General Engineering Science (English pr Focus Biomechanics: Compulsory Mechanical Engineering: Specialisation Bio Biomedical Engineering: Specialisation Bio Compulsory Biomedical Engineering: Specialisation Im Biomedical Engineering: Specialisation Me Biomedical Engineering: Specialisation Me	rogram, 7 semester): Special edical Engineering: Compulsor ogram, 7 semester): Speciali ogram, 7 semester): Speciali omechanics: Compulsory Artificial Organs and Reg plants and Endoprostheses: El edical Technology and Control nagement and Business Admi Elective Compulsory	isation Biomedic y isation Biomedic sation Mechanic generative Med lective Compulso Theory: Elective inistration: Electiv	al Engineering: al Engineering: al Engineering, icine: Elective ry Compulsory

	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:
	 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
Literature	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
	Schiebler T.H., Schmidt W.: Anatomie
	Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat

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Module M1279: M	IED II: Introduction to Bioch	nemistry and Molec	ular Biology	
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry	y and Molecular Biology (L0386)	Lecture	2	3
	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements				
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students I	have reached the following le	earning results	
Professional Competence				
Knowledge	 The students can describe basic biomolecules; explain how genetic information i explain the connection between E 			
Skills	 The students can recognize the importance of mole describe selected molecular-diago explain the relevance of these pro- 	nostic procedures;	urse of a disease;	
Personal Competence				
Social Competence	The students can participate in discussion	ons in research and medicine	e on a technical level.	
Autonomy	The students can develop understand themselves.	ing of topics from the cou	ırse, using technical	literature, k
Workload in Hours	Independent Study Time 62, Study Time	in Lecture 28		
Credit points	3			
Course achievement	None			
Examination				
Examination duration and scale	60 minutes			
Assignment for the Following Curricula	 General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering General Engineering: Specialisation Biomechanics: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory 			

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

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time	e and frequency domain, Laplac	ce transform	
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic syst particular explain properties of first an They can explain the dynamics of simp of frequency response and root locus They can explain the Nyquist stability of They can explain the role of the phase They can explain the way a PID con response They can explain issues arising whe implemented digitally 	d second order systems ole control loops and interpret of criterion and the stability margi margin in analysis and synthes ntroller affects a control loop	lynamic prop ns derived fi is of control in terms o	perties in tern rom it. loops f its frequend
Skills	 Students can transform models of line vice versa They can simulate and assess the beha They can design PID controllers with th They can analyze and synthesize simp response techniques They can calculate discrete-time appruse it for digital implementation They can use standard software tools tasks 	avior of systems and control loc the help of heuristic (Ziegler-Nich ale control loops with the help of poximations of controllers design	ops hols) tuning of root locus ned in contin	rules and frequen nuous-time ar
Personal Competence				
Social Competence	Students can work in small groups to jointly s controller designs	olve technical problems, and e	xperimentan	ly validate the
	Students can obtain information from pro experiment guides) and use it when solving g		, software (documentatio
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.		ng progress.	
Workload in Hours	Independent Study Time 124, Study Time in I	_ecture 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German progra Bioprocess Engineering: Core qualification: Co Computer Science: Specialisation Computation Data Science: Core qualification: Elective Core Electrical Engineering: Core qualification: Core Energy and Environmental Engineering: Core General Engineering Science (English prog Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Engineering: Compulsory General Engineering Science (English progra Engineering: Compulsory General Engineering Science (English progra	ompulsory inal Mathematics: Elective Com npulsory qualification: Compulsory ram, 7 semester): Specialisat ogram, 7 semester): Specialisation am, 7 semester): Specialisation	pulsory tion Electrica lisation Civion Bioproces n Energy an	al Engineerin il Engineerin ss Engineerin d Enviroment

Assignment for the Following Curricula General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 Materials in Engineering Sciences: 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 Theoretical 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 Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
Assignment for the Following CurriculaFocus 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 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 Theoretical Mechanical Engineering: 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 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 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 Gompulsory <b< th=""></b<>
Assignment for the Following Curricula Following Curricula 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 Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus 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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
Assignment for the Following CurriculaFocus 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 Materials in 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 Naval Architecture: 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 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Sci
Assignment for the Following Curricula 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 Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 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 Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Assignment for the Following Curricula Following Curricula 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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 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 Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Following CurriculaGeneral 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 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 Naval Architecture: 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 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 Biomedical Engineering: Compulsory General Engineering Science and Engineering: Core qualification: Compulsory
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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 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 Computational Science and Engineering: Core qualification: Compulsory
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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 Naval Architecture: 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
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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 Naval Architecture: 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 Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
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Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
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General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
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General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Compulsory Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: 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 0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
-	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
<u> </u>	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 plots
Content	 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
	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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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		Тур	Hrs/wk	СР
Numerical Mathematics I (L	0417)	Lecture	2	3
Numerical Mathematics I (L	0418)	Recitation Section (small)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	 Mathematik I + II for Engineering Stu for Technomathematicians basic MATLAB knowledge 	dents (german or english) or Ana	alysis & Line	ar Algebra I +
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional				
Competence				
	Students are able to			
Knowledge	 name numerical methods for interpolation, integration, least squares problems, eigenviloproblems, nonlinear root finding problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computationand storage complexitx. 			
	Students are able to			
Skills	 implement, apply and compare nume justify the convergence behaviour solution algorithm, select and execute a suitable solution 	of numerical methods with res	spect to the	e problem an
Personal Competence				
-	Students are able to			
Social Competence	 work together in heterogeneously cr and background knowledge), expla practical aspects regarding the imple 	in theoretical foundations and		
	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 ir	Lecture 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	90 minutes			
and scale	General Engineering Science (German g	rogram 7 semester): Speciali	sation Com	nuter Science
	Compulsory General Engineering Science (German pro Focus Materials in Engineering Sciences: Co General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Biomechanics: Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering:	gram, 7 semester): Specialisatic mpulsory gram, 7 semester): Specialisatic gram, 7 semester): Specialisatic gram, 7 semester): Specialisatic	on Mechanic on Biomedic on Mechanic	al Engineering al Engineering al Engineering
Assignment for the Following Curricula	Bioprocess Engineering: Specialisation A - G Computer Science: Specialisation Computat Computer Science: Specialisation II. Mather Data Science: Core qualification: Compulso Electrical Engineering: Core qualification: El Engineering Science: Core qualification: Co General Engineering Science (English prog Focus Theoretical Mechanical Engineering: General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog	ional Mathematics: Elective Com natics and Engineering Science: E y ective Compulsory npulsory gram, 7 semester): Specialisatio Elective Compulsory	pulsory Elective Com n Mechanic on: Compuls	al Engineering

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mecha	anical Engineering,
Focus Biomechanics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mecha	anical Engineering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mecha	anical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Biome	dical Engineering:
Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective	Compulsory
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsi	ory
Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Core	Studies: Elective
Compulsory	
Process Engineering: Specialisation Process Engineering: Elective Compulsory	

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

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

		Тур	Hrs/wk	СР
21)		Lecture	3	4
24)		Recitation Section (small)	1	2
Prof. Heiko Falk				
None				
Basic knowledge in ele	ectrical engineering			
After taking part curce	sectully students have	a reached the following learning	roculto	
Alter taking part succe	essiully, students nav		Tesuits	
 This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinir Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses 				
internal structure and the physical composition of computer systems. The students can analyze, he highly specific and individual computers can be built based on a collection of few and simp components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors. S After successful completion of the module, the students are able to judge the interdependenci 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 abstractin layers from the assembly language down to gates. This way, they will be enabled to evaluate this impact that these low abstraction levels have on an entire system's performance and to propo				
Students are able to se	olve similar problems	alone 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 knowled with other classes.				
Independent Study Tir	ne 124, Study Time ir	Lecture 56		
6				
Compulsor B onus	Form Executions	Description		
	Excercises			
	<i>.</i>			
90 minutes, contents o	of course and labs			
	Science (German p	rogram, 7 semester): Special	isation Com	puter Scienc
	Science (German pro	gram, 7 semester): Specialisati	on Bioproce	ss Engineerin
Compulsory Concernal Engineering	Science (German r	rogram 7 semester): Special	isation Nava	Architectu
Compulsory		rogram, / semester). special	isation NaVa	
5 5	Science (German pr	ogram, 7 semester): Specialisa	tion Electric	al Engineerin
General Engineering S	Science (German pro	gram, 7 semester): Specialisati	on Biomedic	al Engineerin
Compulsory General Engineering S	Science (German prod	gram, 7 semester): Specialisatio	on Enerov an	d Enviroment
Engineering: Compulse	ory			
Compulsory	•			5
		gram, 7 semester): Specialisati	on Mechanic	al Engineerin
Focus Mechatronics: C	ompuisory			
	24) Prof. Heiko Falk None Basic knowledge in ele After taking part succe This module deals wit from the assembly-lev Introduction Combinational combinational combinational resequential logic Technological for Computer arithment Basics of computer arithment Basics of computer arithment Basics of computer arithment Basics of computer arithment Structure and highly specific and in components. They are today's computing system a physical of understand the consel layers from the assert impact that these low feasible options. Students are able to set	24) Prof. Heiko Falk None Basic knowledge in electrical engineering After taking part successfully, students have This module deals with the foundations of from the assembly-level programming dowr • Introduction • Combinational logic: Gates, Bool combinational networks • Sequential logic: Flip-flops, automata • Technological foundations • Computer arithmetic: Integer addition • Basics of computer architecture: Prog • Memories: Memory hierarchies, SRAM • Input/output: I/O from the perspect connections, busses The students perceive computer systems internal structure and the physical compuse highly specific and individual computers components. They are able to distinguish today's computing systems - from gates and understand the consequences that the exel layers from the assembly language down impact that these low abstraction levels feasible options. Students are able to solve similar problems Students are able to acquire new knowledwith other classes. Independent Study Time 124, Study Time in feasible options. General Engineering Science (German pro Compulsory General Engineering Science (German p	Prof. Heiko Falk None Basic knowledge in electrical engineering After taking part successfully, students have reached the following learning This module deals with the foundations of the functionality of computing s from the assembly-level programming down to gates. The module includes • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functi combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and Basics of computer architecture: Programming models, MIPS single-C • Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of p connections, busses The students perceive computer systems from the architect's perspect internal structure and the physical composition of computer systems. The highly specific They arable to disputers bate and individue distinguish between aphysical computer system and the software executed on understand the consequences that the execution of software has on the P layers from the assembly language down to gates. This way, they will I larget from the assembly language down to gates. This way, they will I larget between a physical computer system share the software executed on the reasible options. Students are able to solve similar problems alone or in a group and to prese Students are able to acquire new knowledge from specific literature and with other classes. In	24) Recitation Section (small) 1 Prof. Heiko Falk None Basic knowledge in electrical engineering After taking part successfully, students have reached the following learning results After taking part successfully, students have reached the following learning results This module deals with the foundations of the functionality of computing systems. It co from the assembly-level programming down to gates. The module includes the following Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardw combinational networks Sequential logic: Flipfops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architect Memories: Memory hierarchies, SRMA, DRAM, caches Input/output: 1/0 from the perspective of the CPU, principles of passing data connections, busses The students perceive computer systems from the architect's perspective, i.e., the internal structure and the physical composition of computer systems. The students ca highly specific and individual computers can be built based on a collection of ft compare system and the software executed on it. In partici understand the consequences that the execution of software has on the hardware-cen layers from the assembly language down to gates. This way, they will be enable to indusivable bave and an entire system's performance of teasible options. Students are able to solve similar problems alone or i

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	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 Sciences (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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	Computer Science: Core qualification: Compulsory
Assignment for the	Data Science: Core qualification: Elective Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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	 Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output
Literature	 A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.

Course L0324: Compute	urse 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 Experimental Methods in Bio	omechanics (L0377)	Typ Lecture	Hrs/wk 2	СР 3
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimente Methoden".			
Educational Objectives	After taking part successfully, stu	dents have reached the following lear	ning results	
Professional Competence	The students can describe the dif	ferent ways how bones heal, and the in It treatments for the spine and holl		
Knowledge	morphologies.	ent measurement techniques for forc		-
Skills	The students can describe th biomechanics.	ne basic handling of several exp	erimental techn	iques used
Personal Competence				
Social Competence	The students can, in groups, solve	e basic experimental tasks.		
Autonomy	The students can, in groups, solve	e basic experimental tasks.		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points				
Course achievement				
	Written exam			
Examination duration and scale				
	Focus Biomechanics: Compulsory General Engineering Science (Ge Compulsory Engineering Science: Specialisatio	erman program, 7 semester): Specia on Biomedical Engineering: Elective Co	lisation Biomedic	5
Assignment for the Following Curricula	Compulsory General Engineering Science (Er Elective Compulsory Mechanical Engineering: Specialis Biomedical Engineering: Speci Compulsory Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis	nglish program, 7 semester): Special nglish program, 7 semester): Special	lisation Biomedic lisation Biomedic generative Med lective Compulso Theory: Elective inistration: Electi	al Engineerir al Engineerir licine: Electi ory Compulsory
Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (Er Compulsory General Engineering Science (Er Elective Compulsory Mechanical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis	nglish program, 7 semester): Special nglish program, 7 semester): Special sation Biomechanics: Compulsory alisation Artificial Organs and Re sation Implants and Endoprostheses: E sation Medical Technology and Control sation Management and Business Adm on III. Engineering Science: Elective Co	lisation Biomedic lisation Biomedic generative Med lective Compulso Theory: Elective inistration: Electi	al Engineerir al Engineerir licine: Electi ory Compulsory
Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (Er Compulsory General Engineering Science (Er Elective Compulsory Mechanical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis	nglish program, 7 semester): Special nglish program, 7 semester): Special sation Biomechanics: Compulsory alisation Artificial Organs and Re sation Implants and Endoprostheses: E sation Medical Technology and Control sation Management and Business Adm on III. Engineering Science: Elective Co	lisation Biomedic lisation Biomedic generative Med lective Compulso Theory: Elective inistration: Electi	al Engineerin al Engineerin licine: Electi ory Compulsory
Following Curricula	Focus Biomechanics: Compulsory General Engineering Science (Er Compulsory General Engineering Science (Er Elective Compulsory Mechanical Engineering: Specialis Biomedical Engineering: Specialis	nglish program, 7 semester): Special nglish program, 7 semester): Special sation Biomechanics: Compulsory alisation Artificial Organs and Re sation Implants and Endoprostheses: E sation Medical Technology and Control sation Management and Business Adm on III. Engineering Science: Elective Co	lisation Biomedic lisation Biomedic generative Med lective Compulso Theory: Elective inistration: Electi	al Engineerin al Engineerin licine: Electiv ory Compulsory
Following Curricula Course L0377: Experim Typ	Focus Biomechanics: Compulsory General Engineering Science (Er Compulsory General Engineering Science (Er Elective Compulsory Mechanical Engineering: Specialis Biomedical Engin	nglish program, 7 semester): Special nglish program, 7 semester): Special sation Biomechanics: Compulsory alisation Artificial Organs and Re sation Implants and Endoprostheses: E sation Medical Technology and Control sation Management and Business Adm on III. Engineering Science: Elective Co	lisation Biomedic lisation Biomedic generative Med lective Compulso Theory: Elective inistration: Electi	al Engineerin al Engineerin licine: Electiv ory Compulsory

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

Courses		
Title Introduction to Physiology (I	Typ Hrs/wk CP L0385) Lecture 2 3	
Module Responsible	Dr. Roger Zimmermann	
Admission Requirements		
Recommended Previous Knowledge	None	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	 describe the basics of the energy metabolism; describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sens physiology. 	
Skills	The students can describe the effects of basic bodily functions (sensory, transmission and processing information, development of forces and vital functions) and relate them to similar technical systems	
Personal Competence		
Social Competence	The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrologic	
Autonomy	The students can derive answers to questions arising in the course and other physiological areas, us technical literature, by themselves.	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Credit points	3	
Course achievement		
Examination		
Examination duration and scale	60 minutes	
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Elective Compulsory Mechanical 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: Electiv Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

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

Courses				
Title Management Tutorial (L0882) Introduction to Management (L0880)		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional Competence				
Knowledge	 After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management and marketing 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 state basics from accounting and costing and selected controlling methods. 			
Skills	 strategies etc.) and to carry out an Entreprener analyse Management goals and structure analyse organisational and staff structur apply methods for decision making unde analyse production and procurement system analyse and apply basic methods of mar select and apply basic methods from matical 	Iff structures of companies aking under multiple objectives, under uncertainty and under risk rement systems and Business information systems		
Personal Competence				
	Students are able to			
Social Competence	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project to communicate appropriately and to cooperate respectfully with their fellow students. 			
	Students are able to			
Autonomy	work in a team and to organize the team themselvesto write a report on their project.			
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Course achievement				
	Subject theoretical and practical work			
Examination duration	several written exams during the semester			
	General Engineering Science (German program Civil- and Environmental Engineering: Core qua Civil- and Environmental Engineering: Specialis Civil- and Environmental Engineering: Specialis Civil- and Environmental Engineering: Specialis Bioprocess Engineering: Core qualification: Com Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Comp Energy and Environmental Engineering: Core	lification: Compulsory ation Civil Engineering: Electi ation Water and Environment ation Traffic and Mobility: Ele npulsory ory oulsory	ve Compulso :: Elective Co	ory ompulsory

I	Consul Environment Chinese (Environment 7 consists), Consisting Electrical Environment
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	Construction Colored (Feelink and a 7 and also). Constallation Markeniael Feeline day
Following Curricula	
r onowing curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
1	Process Engineering: Core qualification: Compulsory

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

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

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.

Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L0321) Computer Engineering (L0324)			Lecture Recitation Section	3 (small) 1	4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous Knowledge	Basic knowledge in el	ectrical engineer	ng		
Educational Objectives	After taking part succ	essfully, students	have reached the following le	arning results	
Professional Competence Knowledge Skills	This module deals wit from the assembly-lev Introduction Combinational combinational Sequential logi Technological f Computer arith Basics of comp Memories: Men Input/output: I connections, but The students perceive internal structure and highly specific and components. They ar today's computing system After successful comp between a physical	vel programming logic: Gates, networks c: Flip-flops, auto foundations imetic: Integer ac uter architecture nory hierarchies, /O from the per usses ve computer system d the physical co individual compu- re able to disting stems - from gate poletion of the m	s of the functionality of comp down to gates. The module ind Boolean algebra, Boolean mata, systematic hardware de dition, subtraction, multiplicat Programming models, MIPS s SRAM, DRAM, caches spective of the CPU, principle terms from the architect's pr mposition of computer system iters can be built based on uish between and to explain es and circuits up to complete module, the students are able n and the software execute	cludes the followi functions, hard sign ion and division ingle-cycle archit es of passing da erspective, i.e., ns. The students a collection of the different abs processors. e to judge the i d on it. In part	ng topics: dware synthes ecture, pipelinin ata, point-to-po they identify t can analyze, hu few and simp traction layers nterdependenci icular, they sh
Personal Competence	layers from the asse impact that these lo feasible options.	mbly language o w abstraction le	e execution of software has on lown to gates. This way, they vels have on an entire syste	y will be enabled m's performance:	d to evaluate t and to propo
Social Competence	Students are able to s	solve similar prob	lems alone or in a group and to	o present the res	ults accordingly
Autonomy	Students are able to with other classes.	acquire new kno	wledge from specific literature	e and to associal	te this knowled
Workload in Hours	Independent Study Ti	me 124, Study Ti	me in Lecture 56		
Credit points	6				
Course achievement	Compulsor B onus Yes 10 %	Form Excercises	Description		
Examination	Written exam				
Examination duration	90 minutes, contents	of course and lab)S		

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

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

Course L0324: Compute	urse 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
Signals and Systems (L0432	?)	Lecture	3	4
Signals and Systems (L0433	3)	Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Requirements	Mathematics 1-3			
	The modul is an introduction to the theory of sigr by the moduls Mathematik 1-3 is expected. Furt series, Fourier transform, Laplace transform) is u	her experience with spectr		
Educational Objectives	After taking part successfully, students have read	hed the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe methods of signal and system theory. They ar continuous-time and discrete-time signals and s signals and systems mathematically in both time effects in time domain and image domain whic signal to a discrete-time signal.	e able to apply the funda ystems. They can describe and image domain. In part h are caused by the trans	mental trai and analysticular, they sition of a	nsformations se determinis understand f continuous-tii
Skills	The students are able to describe and analyse of using methods of signal and system theory. The important properties such as magnitude and ph the impact of LTI systems on the signal properties	ey can analyse and desig ase response, stability, line	n basic sys arity etc 1	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant infor control their level of knowledge during the lectu clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program Compulsory General Engineering Science (German program, Focus Biomechanics: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory General Engineering Science (German program, Focus Energy Systems: Compulsory	m, 7 semester): Speciali n, 7 semester): Specialisatio , 7 semester): Specialisatio , 7 semester): Specialisatio , 7 semester): Specialisatio	sation Con ation Proce on Bioproce on Biomedia on Mechania on Mechania	nputer Scien ss Engineeri cal Engineeri cal Engineeri cal Engineeri
Assignment for the Following Curricula	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, Focus Materials in Engineering Sciences: Compuls General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Comp Computer Science: Core qualification: Compulsor Electrical Engineering: Core qualification: Compul General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program,	sory 7 semester): Specialisatio 17 semester): Specialisatio ulsory y sory , 7 semester): Specialisat m, 7 semester): Specialisa	on Mechanic on Mechanic cion Electric sation Com ation Proce	cal Engineerin cal Engineerin cal Engineerin nputer Scien ss Engineeri

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

	omputational Fluid Dy			
Courses				
Title Computational Fluid Dynam Computational Fluid Dynam		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 3
		Recitation Section (large)	Z	J
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematical Methods forFundamentals of Differenti	Engineers al/integral calculus and series expansions		
Educational Objectives	After taking part successfully, stu	dents have reached the following learning	results	
Professional				
Competence Knowledge	The students are able to list the b	basic numerics of partial differential equation	ons.	
Skills		ppropriate numerical integration in space y can code computational algorithms in a s		
Personal Competence	The students can arrive at work r	esults in groups and document them.		
Autonomy	The students can independently a	analyse approaches to solving specific prob	lems.	
Workload in Hours	Independent Study Time 124, Stu	idy Time in Lecture 56		
Credit points		-		
Course achievement	None			
Examination				
Examination duration	2h			
and scale		rman program 7 competer). Considiratio		d Environan
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviro Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Archi Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir Focus Energy Systems: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviro Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviro Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engir Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviro Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviro Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviro Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviro Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engir Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engir Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Archi Compulsory Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			cal Engineerir cal Engineerir nd Enviromen cal Engineerir nd Enviromen nd Enviromen cal Engineerir

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

Course L0419: Computa	ourse L0419: Computational Fluid Dynamics I		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Thomas Rung		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses Fitle Indvanced Mechanical Engine Indvanced Mechanical Engine Indvanced Mechanical Engine Indvanced Mechanical Engine Module Responsible Admission		_		
Module Responsible	eering Design I (L0262)	Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 2 2 2	CP 2 1 2 1
		Recitation Section (large)	Z	1
Admission				
Requirements				
Recommended Previous Knowledge		ring Design		
ducational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
	After passing the module, students are able			
Knowledge	 explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples of complex machine elements, indicate the background of dimensioning calculations. 			
	After passing the module, students are able	to:		
Skills	 accomplish dimensioning calculations transfer knowledge learned in the skills), recognize the content of technical drate evaluate complex designs, technically 	module to new requirements a awings and schematic sketches,	nd tasks (pro	oblem solvin
Personal Competence				
Social Competence	 Students are able to discuss technic methods. 	nical information in the lecture	e supported	by activating
Autonomy	 Students are able to independently description Students are able to acquire addition e.g. by using the video recordings of the video	al knowledge and to recapitulate		stood conten
Workload in Hours	Independent Study Time 68, Study Time in I	Lecture 112		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	120			
	General Engineering Science (German prog Compulsory General Engineering Science (German prog Focus Biomechanics: Compulsory General Engineering Science (German prog Focus Energy Systems: Compulsory General Engineering Science (German prog Focus Aircraft Systems Engineering: Compul	gram, 7 semester): Specialisatio gram, 7 semester): Specialisatio gram, 7 semester): Specialisatio	on Mechanica on Mechanica	I Engineering
	General Engineering Science (German prog Focus Materials in Engineering Sciences: Co General Engineering Science (German prog	gram, 7 semester): Specialisatic mpulsory		
	Focus Mechatronics: Compulsory General Engineering Science (German prog Focus Product Development and Production General Engineering Science (German prog	gram, 7 semester): Specialisatic : Compulsory gram, 7 semester): Specialisatic	on Mechanica	l Engineering
Assignment for the Following Curricula	Focus Theoretical Mechanical Engineering: C Energy Systems: Technical Complementary Engineering Science: Specialisation Mechan	Compulsory Course Core Studies: Elective Co ical Engineering: Compulsory	ompulsory	

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 Product Development and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
Mechanical Engineering: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory

Lecturer Prof Language DE Cycle SoS Adv Lec Content Exe	lependent Study Time 32, Study Time in Lecture 28 of. Dieter Krause, Prof. Otto von Estorff Se Vanced Mechanical Engineering Design I & II cture • 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 ercise
CP 2 Workload in Hours Inde Lecturer Prof Language DE Cycle SoS Adv Lec Content Exe	of. Dieter Krause, Prof. Otto von Estorff Se Vanced Mechanical Engineering Design I & II cture • 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 ercise
Workload in Hours Inde Lecturer Prof Language DE Cycle SoS Adv Lect Content Exe	of. Dieter Krause, Prof. Otto von Estorff Se Vanced Mechanical Engineering Design I & II cture • 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
Lecturer Prof Language DE Cycle SoS Adv Lec Content Exe	of. Dieter Krause, Prof. Otto von Estorff Se Vanced Mechanical Engineering Design I & II cture • 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
Language DE Cycle SoS Adv Lec Content Exe	Se Ivanced Mechanical Engineering Design I & II cture • 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
Cycle SoS Adv Lec Content Exe	Se Ivanced Mechanical Engineering Design I & II cture • 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 ercise
Adv Lec Content Exe	 vanced Mechanical Engineering Design I & II cture 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
Lec Content Exe	 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
Content Exe	 Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Crank drives Sliding bearings Elements of fluidics
	 Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Crank gears Sliding bearings Calculations of hydrostatic systems (fluidics)
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

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

irse L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Silding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Gear drives • Gear drives • Cank gears
Literature	 Sliding bearings Calculations of hydrostatic systems (fluidics) 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, aktuell Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg aktuelle Auflage.

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

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
		Recitation Section (Smail)	-	-
Module Responsible	Prof. Herbert werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems ir	n time and frequency domain, Lapla	ce transform)
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally 			
Skills	 Students can transform models of vice versa They can simulate and assess the They can design PID controllers w They can analyze and synthesize response techniques They can calculate discrete-time use it for digital implementation They can use standard software tasks 	behavior of systems and control lo ith the help of heuristic (Ziegler-Nic simple control loops with the help approximations of controllers desig	ops hols) tuning of root locus Ined in conti	rules and frequen nuous-time ar
Personal Competence				
Social Competence	Students can work in small groups to join	ntly solve technical problems, and e	experimental	ly validate the
	controller designs Students can obtain information from experiment guides) and use it when solv	provided sources (lecture notes		
Autonomy	They can assess their knowledge in wee	kly on-line tests and thereby contro	l their learniı	ng progress.
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German pr Bioprocess Engineering: Core qualificatio Computer Science: Specialisation Compu Data Science: Core qualification: Elective Electrical Engineering: Core qualification Energy and Environmental Engineering: General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English Compulsory	on: Compulsory utational Mathematics: Elective Com e Compulsory I: Compulsory Core qualification: Compulsory program, 7 semester): Specialisa n program, 7 semester): Specia	npulsory tion Electric Ilisation Civ	al Engineerin il Engineerin

Assignment for the Following Curricula General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 Materials in Engineering Sciences: 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 Theoretical 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 Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
Assignment for the Following CurriculaFocus 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 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 Theoretical Mechanical Engineering: 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 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 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 Gompulsory <b< th=""></b<>
Assignment for the Following Curricula Following Curricula 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 Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus 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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
Assignment for the Following CurriculaFocus 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 Materials in 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 Naval Architecture: 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 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Sci
Assignment for the Following Curricula 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 Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 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 Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Assignment for the Following Curricula Following Curricula 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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 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 Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Following CurriculaGeneral 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 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 Naval Architecture: 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 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 Biomedical Engineering: Compulsory General Engineering Science and Engineering: Core qualification: Compulsory
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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 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 Computational Science and Engineering: Core qualification: 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 Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
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 Naval Architecture: 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: 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 Naval Architecture: 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 Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
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 Naval Architecture: 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 Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: 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 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 Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Compulsory Computational Science and Engineering: Core qualification: Compulsory
Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory
Compulsory Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: 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 10654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
	Prof. Herbert Werner
Language	
Cycle	
	 Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response
	 Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection
	 Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques
	 Root locus plots Root locus design of PID controllers Frequency response techniques
Content	 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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

	eat Transfer				
Courses					
Title	Тур	Hrs/wk	СР		
Heat Transfer (L0458)	Lecture	3	4		
Heat Transfer (L0459)	Recitation Section (lar	rge) 2	2		
	Dr. Andreas Moschallski				
Requirements	None				
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics				
Educational Objectives	After taking part successfully, students have reached the following learn	ning 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 groups and develop an approach.				
	The students are able to develop a complex problem self-consistent and way. A qualified exchange with other students is given.	d analyse the res	sults in a critica		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and scale	120 min				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Elective Compulsory 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 Theoretical Mechanical Engineering: Compulsory Energy Systems: Technical Complementary Course Core Studies: 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 Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory				

ourse L0458: Heat Tra	ansfer
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, Heat Conduction (steady and unsteady), Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

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

Module M1022: R	eciprocating Machinery			
Courses				
Title Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating		Typ Lecture	Hrs/wk	CP
Engines (L0633) Fundamentals of Reciprocat Engines (L0634)	ing Engines and Turbomachinery - Part Reciprocating	Recitation Section (large)	1	1
Internal Combustion Engine Internal Combustion Engine		Lecture Recitation Section (large)	2 1	2 2
Module Responsible	Prof. Christopher Friedrich Wirz			
Admission Requirements	None			
Recommended Previous Knowledge	Thermodynamics, Mechanics, Machine Elements			
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence				
-	The students are able to communicate and coo machinery design and application.	rking machinery and de s and efficiencies of m e technical terms and par and efficiency, furthermon nts are able to select spect on Engines I", the student addition, they are able to ristics and the approach of s charging systems. Deta il knowledge regarding re- assess, analyse and solv lynamic design.	scribe the nultiple typ ameters as re to give cific types or s are able re o utilize the f similarity. T ailed knowle ciprocating t e technical	qualitative and es of engines well as aspect an overview of machinery and effect and utilize ir knowledge of They are able to edge is presen machinery, thei and operationa
Autonomy	The widespread scope of gained knowledge enables the students to handle situations in their futur profession independently and confidently.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Course achievement	None			
	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Energy Systems: Compulsory Energy and Environmental Engineering: Core qualification: Elective Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory			

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

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

Course L0059: Internal	Combustion Engines I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Thiemann
Language	DE
Cycle	SoSe
Content	 The beginnings of engine development Design of of motors Real process calculation Charging methods Kinematics of the crank mechanism Forces in the engine
Literature	 Vorlesungsskript Übungsaufgaben mit Lösungsweg Literaturliste

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

Courses					
Title Gas and Steam Power Plant Gas and Steam Power Plant	. ,		Typ Lecture Recitation Section (large	Hrs/wk 3 1	CP 5
Module Responsible NN			Reclation Section (large	-	-
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part succe	essfully, students hav	e reached the following learnin	g results	
Professional					
Competence <i>Knowledge</i>	The students can evaluate the development of the electricity demand and the energy conversion rout in the thermal power plant, describe the various types of power plant and the layout of the stea generator block. They are also able to determine the operation characteristics of the power plan Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plan equipped with Carbon Capture and Storage.				
Skills	The students will be able, using theories and methods of the energy technology from fossil fuels a based on well-founded knowledge on the function and construction of gas and steam power plants, identify basic associations in the production of heat and electricity, so as to develop concepts solutions. Through analysis of the problem and exposure to the inherent interplay between heat a power generation the students are endowed with the capability and methodology to develop realis optimal concepts for the generation of electricity and the production of heat. From the technical bas the students become the ability to follow better the deliberations on the electricity mix composit 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 su EBSILON Professional TM . With this tool small practical tasks are solved with the PC, to highlight aspe of the design and development of power plant cycles. The students are able to do simplified calculations on turbomachinery either as part of a plant, as sin component or at stage level.				
Personal Competence					
Social 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 wi obtain first-hand experience with a power plant in operation and gain insights into the conflict between technical and political issues.				
Autonomy	these scenario analys consolidated and the highlighted. The stud	ses. In this manner t potential effects fro ents are able indepe	able to develop alone simple sin he theoretical and practical kn m different process combination andently to analyse the opera ties and characteristic curves.	nowledge from	m the lecture dary conditio
Workload in Hours	Independent Study Tir	ne 124, Study Time i	n Lecture 56		
Credit points	6				
	Compulsor B onus	Form	Description		
Course achievement	No 5 % No 5 %	Attestation Excercises	15-minütiges, unben Professional; nur (keine anteiligen Punl 10 Übungsaufgaben i Minuten; bis zu 5 % E Abgaben	bestanden/nio kte) m Laufe der V	cht bestand Vorlesungen à
	Written exam				
Examination duration and scale	Written examination o	f 120 min			
	General Engineering S Engineering: Elective (Science (German pro Compulsory Science (German pro	gram, 7 semester): Specialisat ogram, 7 semester): Specialisa y		

Assignment for the Following Curricula Following Curricula Benergy Systems: Technical Complementary Course Core Studies: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Course L0206: Gas and	Steam Power Plants
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including: • Electricity demand and Forecasting • Thermodynamic fundamentals • Energy Conversion in thermal power plants • Types of power plant • Layout of the power plant block • Individual elements of the power plant • Cooling systems • Flue gas cleaning • Operation characteristics of the power plant • Construction materials for power plants • Location of power plants • Location of power plants • Solar thermal plants/geothermal plants/Carbon Capture and Storage plants. These are complemented in the 2 nd part of the module by the more specialised issues: • Energy balance of a turbomachine • Theory of turbine and compressor stage • Equal and positive pressure blading • Flow losses • Axial and radial design • Design features • Hydraulic turbomachines • Pump and water turbine designs • Design examples of reciprocating engines and turbomachinery • Steam power plants
Literature	 Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

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	Recitation Section (large)
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alfons Kather
Language	DE
Cycle	WiSe
Content	In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plant 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 • Diseel engine systems • Diseel engine systems • Uiseel engine systems • Uise for the fore the systems • Uise of Power Plant • Electricity Demand and Forecasting • Thermodynamic fundamentals • Energy Conversion in Thermal Power Plants • Types of Power Plant • Layout of the power plant • Cooling systems • Flue gas cleaning • Operation characteristics of the power plant • Cooling systems • Flue gas cleaning • Operation characteristics of the power plant • Cooling systems • Location of power plants The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting clime effects are a special focus of the lecture and the lecture hall exercise. The challenges in plant opera from interconnecting conventional power plants and renewable energy sources are discussed and technical options for providing security of supply and network stability are presented, also ur consideration of cost effectiveness. In this critical review, focus is especially placed on the compatib of the different solutions with the environment and climate. With this, the awareness for responsibility of an engineer's own actions are emphasized and the potential extent of the differ solutions presented clearly. Within the framework of the exercise the students learn the use of the specialised software se EBSILON Professional TM . With this tool small tasks are solved on th
Literature	 Skripte Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwer

Courses				
Fitle Management Tutorial (L088 ntroduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busine	55		
ducational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 After taking this module, students know the important basics of many different areas in Business an Management, from Planning and Organisation to Marketing and Innovation, and also to Investment an Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, suppl chain management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematic. Finance state basics from accounting and costing and selected controlling methods. 			
Skills	 strategies etc.) and to carry out an Entreprenert analyse Management goals and struct analyse organisational and staff struct apply methods for decision making un analyse production and procurement standyse and apply basic methods of methods from reselect and apply basic methods from rese	aff structures of companies haking under multiple objectives, under uncertainty and under risk urement systems and Business information systems		
Personal Competence				
-	Students are able to			
Social Competence	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coher report on the project to communicate appropriately and to cooperate respectfully with their fellow students. 		rite a coheren	
	Students are able to			
Autonomy	 work in a team and to organize the tea to write a report on their project. 	am themselves		
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
Course achievement				
Examination	Subject theoretical and practical work			
Examination duration	several written exams during the semester			
	General Engineering Science (German progra Civil- and Environmental Engineering: Core q Civil- and Environmental Engineering: Specia Civil- and Environmental Engineering: Specia Bioprocess Engineering: Core qualification: Core puter Science: Core qualification: Computer Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Core Energy and Environmental Engineering: Core	ualification: Compulsory lisation Civil Engineering: Electi lisation Water and Environment lisation Traffic and Mobility: Ele ompulsory llsory mpulsory	ve Compulso : Elective Co	ory mpulsory

1	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	
5	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
1	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
ı	Process Engineering: Core qualification: Compulsory

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

urse LU880: Introduc	tion to Management		
Тур	Lecture		
Hrs/wk	3		
СР	3		
	Independent Study Time 48, Study Time in Lecture 42		
	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language			
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategi information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects 		
Literature	 Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. 		

Module M0618: R	enewables and Energy Systems	5		
Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Renewable Energy (10313)	Industry (L0315)	Lecture Lecture	2 2	2 2
Renewable Energy (L0313) Renewable Energy (L1434)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous Knowledge	none			
	After taking part successfully, students have r	eached the following learning	results	
Professional Competence				
Knowledge	With completion of this module, the students can provide an overview of characteristics of energy systems and their economic efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, power distribution and power trading will regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss them Furthermore, the students can explain the environmental benefits from the use of such systems.			
Skills	Students are able to apply methodologies f production for various types of energy sys technically, environmentally and economica Therefore, they can choose the necessary su solutions of a problem.	tems. Furthermore, they can ally and design them under	evaluate e certain gi	energy systems ven conditions
	The students are able to explain questions ar renewable energies orally and to put them the		processing 1	from the field c
Personal Competence				
Social Competence	The students are able to analyze suitable technical alternatives and to assess them with technica economical and ecological criteria under sustainability aspects. This allows them to make an effective contribuition to a more sustainable power supply.			
Autonomy	Students can independently exploit sources , 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 Le	cture 84		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	3 hours written exam			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Environe Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Enginee Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enginee Focus Energy Systems: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enginee Focus Energy Systems: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environe Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environe Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Enginee Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Enginee Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Enginee Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Enginee Focus Energy Systems: Elective Compulsory		ss Engineering cal Engineering cal Engineering ory ulsory ompulsory ad Enviromenta cal Engineering	

Course L0316: Power In	ourse L0316: Power Industry		
Тур	Lecture		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Martin Kaltschmitt, Prof. Andreas Wiese		
Language	DE		
Cycle	SoSe		
Content	 Electrical energy in the energy system Demand and use of electrical energy (households, industry, "new" buyers (including e-mobility)) Electricity generation electricity generation technologies using fossil fuels and their characteristics combined heat and power technologies and their production characteristics electricity generation from renewable energy technologies and their characteristics Power distribution "classic" distribution of electrical energy challenges of fluctuating electricity generations trading) District heating industry Legal and administrative aspects Energy Act support instruments for renewable energy CHP Act 		
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	 Energy: development and significance Fundamentals and basic concepts Energy demand and future trends (heat, electricity, fuels) Energy reserve and sources Cost and efficiency calculation Final and effective energy from petroleum, natural gas, coal, uranium and other Legal, administrative and organizational aspects of energy systems Energy systems as a permanent optimization task 		
Literature	• Kopien der Folien		

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

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

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.

Courses				
litle		Тур	Hrs/wk	СР
Advanced Mechanical Engin	eering Design II (L0264)	Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large)	2	1
Advanced Mechanical Engin		Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large)	2	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	 Fundamentals of Mechanical Engine Mechanics Fundamentals of Materials Science Production Engineering 	ering Design		
ducational Objectives	After taking part successfully, students have	ve reached the following learning	results	
Professional Competence				
Knowledge	 After passing the module, students are able to: explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples of complex machine elements, indicate the background of dimensioning calculations. 			
Skills	 After passing the module, students are abl accomplish dimensioning calculation transfer knowledge learned in the skills), recognize the content of technical d evaluate complex designs, technica 	ns of covered machine elements, module to new requirements a rawings and schematic sketches,	and tasks (j	problem solvii
Personal Competence				
Social Competence	 Students are able to discuss technology, methods. 	nnical information in the lectur	e supporte	d by activatir
Autonomy	 Students are able to independently Students are able to acquire additio e.g. by using the video recordings o 	nal knowledge and to recapitulate		
Workload in Hours	Independent Study Time 68, Study Time in	Lecture 112		
Credit points	6			
Course achievement	None			
	Written exam			
Examination duration and scale	120			
	General Engineering Science (German pr Focus Aircraft Systems Engineering: Comp General Engineering Science (German pr Focus Materials in Engineering Sciences: C General Engineering Science (German pr Focus Mechatronics: Compulsory General Engineering Science (German pr Focus Product Development and Productio	ulsory ogram, 7 semester): Specialisati ompulsory ogram, 7 semester): Specialisati ogram, 7 semester): Specialisati	on Mechanio on Mechanio	cal Engineerin

	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	Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

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

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

Courses				
Title Signals and Systems (L043)	2)	Typ Lecture	Hrs/wk	CP 4
Signals and Systems (L043)		Recitation Section (small)		2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of si by the moduls Mathematik 1-3 is expected. Fu series, Fourier transform, Laplace transform) is	urther experience with spectr		
Educational Objectives	After taking part successfully, students have re	ached the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems us 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 determini signals and systems mathematically in both time and image domain. In particular, they understand effects in time domain and image domain which are caused by the transition of a continuous-ti signal to a discrete-time signal.			
Skills	The students are able to describe and analyse using methods of signal and system theory. important properties such as magnitude and p the impact of LTI systems on the signal propert	They can analyse and design bhase response, stability, line	n basic syst arity etc T	ems regardi
Personal Competence	1			
Social Competence	The students can jointly solve specific problems			
Autonomy	The students are able to acquire relevant info control their level of knowledge during the lec clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	lun min			
	General Engineering Science (German progra	am, 7 semester): Specialisat	ion Electric	al Engineerir
	Compulsory			
	General Engineering Science (German prog	ram, / semester): Speciali	sation Com	puter Scien
	Compulsory			•
	Compulsory General Engineering Science (German progr			•
	Compulsory	am, 7 semester): Specialisa	ation Proce	ss Engineerir
	Compulsory General Engineering Science (German progr Compulsory General Engineering Science (German progra Compulsory	am, 7 semester): Specialisa m, 7 semester): Specialisatio	ation Proce	ss Engineerir ss Engineerir
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	Compulsory General Engineering Science (German progr Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Focus Biomechanics: Compulsory	ram, 7 semester): Specialisa m, 7 semester): Specialisatio m, 7 semester): Specialisatio m, 7 semester): Specialisatio	ation Proces on Bioproce on Biomedic on Mechanic	ss Engineerir ss Engineerir al Engineerir al Engineerir
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Assignment for the Following Curricula	Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Focus Biomechanics: Compulsory General Engineering Science (German progra Focus Energy Systems: Compulsory General Engineering Science (German progra Focus Aircraft Systems Engineering: Compulsor General Engineering Science (German progra Focus Materials in Engineering Sciences: Comp General Engineering Science (German progra Focus Materials in Engineering Sciences: Comp General Engineering Science (German progra Focus Mechatronics: Compulsory General Engineering Science (German progra Focus Theoretical Mechanical Engineering: Com Computer Science: Core qualification: Compuls Electrical Engineering Science (English progra Compulsory General Engineering Science (English progra	ram, 7 semester): Specialisa m, 7 semester): Specialisatio m, 7 semester): Specialisatio	ation Proces on Bioproce on Biomedia on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic sation Com ation Proces on Bioproce	ss Engineerir ss Engineerir al Engineerir al Engineerir al Engineerir al Engineerir al Engineerir al Engineerir al Engineerir puter Sciencess Engineerir

Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Biomechanics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Energy Systems: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Aircraft Systems Engineering: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Materials in Engineering Sciences: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Mechatronics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Theoretical Mechanical Engineering: Compulsory		
Computational Science and Engineering: Core qualification: Compulsory		
Mechatronics: Core qualification: Compulsory		
Technomathematics: Specialisation III. Engineering Science: Elective Compulsor	ry	

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

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

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Module M1320: S	imulation and Design of Mechatro	nic Systems		
Courses				
Title Simulation and Design of Mo Simulation and Design of Mo Simulation and Design of Mo	echatronic Systems (L1823)	Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 1 1	CP 2 2 2
Module Responsible	Prof Llwe Weltin			
Admission	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory and e	lectrical engineering		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence Knowledge	Students are able to describe methods and calculations for design, modeling, simulation and			
	optimization of mechatronic systems. Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify, simulate and design simple systems and implement those in laboratory conditions.			
Personal Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups.			
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 a further			
Workload in Hours	course of study. Independent Study Time 124, Study Time in Lectu	ro 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale				
	General Engineering Science (German program, Focus Mechatronics: Compulsory General Engineering Science (German program, Focus Aircraft Systems Engineering: Compulsory Digital Mechanical Engineering: Core qualification: General Engineering Science (English program, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, Focus Mechatronics: Compulsory General Engineering Science (English program, Focus Theoretical Mechanical Engineering: Elective Mechanical Engineering: Specialisation Aircraft Sys Mechanical Engineering: Specialisation Mechatron Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Specialisation Theoretica Mechanical Engineering: Specialisation Theoretica Mechanical Engineering: Specialisation Theoretica Mechanical Engineering: Specialisation Theoretica	7 semester): Specialisatio Compulsory 7 semester): Specialisatio 7 semester): Specialisatio 7 semester): Specialisatio e Compulsory stems Engineering: Compu ics: Compulsory I Mechanical Engineering:	on Mechanic on Mechanic on Mechanic on Mechanic ulsory Compulsory	al Engineering, al Engineering, al Engineering, al Engineering,

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

Course L1823: Simulati	urse 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: Simulati	ourse L1824: Simulation and Design of Mechatronic Systems	
Тур	Practical Course	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Uwe Weltin	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0596: A	dvanced Mecha	nical Design P	roject		
Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Desig	n Project (L0266)		Project-/problem-based Learning	4	6
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	··· · J	ineering: Design anical Engineering De	sign		
Educational Objectives	After taking part succe	ssfully, students have	reached the following learning	ng results	
Professional Competence		ule, students are able	to:		
Knowledge	 express the pro complex design describe workin explain guidelin explain advance 	cedure for systematica tasks , g principles, their use les for designing for fu ed use-oriented knowle	ally handling of and combination possibilities nction and manufacturing, edge of machine elements.	,	
Skills	 After passing the module, students are able to: analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, use methods to design and solve engineering design tasks systematically and solution-oriented, create a technical documentation including all necessary technical drawings to understand the functions of the system, document calculations of selected machine elements clearly and in detail. 				
Personal Competence	i	ula studente ere able	to.		
Social Competence			hnical drawings within groups	5,	
Autonomy		solve complex design selecting appropriate	projects, while motivating the	emselves, acqı	uiring necessa
Workload in Hours	Independent Study Tin	ne 124, Study Time in	Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus Yes None	Form Attestation	Description		
	Written exam				
Examination duration and scale	180				
Assignment for the Following Curricula	Focus Aircraft Systems General Engineering S Focus Product Develop General Engineering S Focus Theoretical Mec General Engineering S Focus Aircraft Systems General Engineering S Focus Product Develop	s Engineering: Compul Science (German prog oment and Production: Science (German prog hanical Engineering: E Science (English prog s Engineering: Compul Science (English prog oment and Production: Science (English prog	ram, 7 semester): Specialisa Compulsory Iram, 7 semester): Specialisa lective Compulsory ram, 7 semester): Specialisa sory ram, 7 semester): Specialisa Compulsory ram, 7 semester): Specialisa	ation Mechanic ation Mechanic ation Mechanic ation Mechanic	cal Engineerin cal Engineerin cal Engineerin cal Engineerin

ourse L0266: Advance	ed Mechanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
Content	 Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung. Getriebekonstruktion in Einzelarbeit Erarbeitung von Lösungsprinzipien Berechnung von Maschinenelementen Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten Erstellung einer ausführlichen Dokumentation Lösungsfindung Methodische Erarbeitung von prinzipiellen Lösungskonzepten Erstellen einer Dokumentation
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
Module Responsible				
Admission	FIGI. Herbert Werner			
Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	time and frequency domain, Lapla	ce transform	
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence		<u>_</u>		
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain at vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequen response techniques They can calculate discrete-time approximations of controllers designed in continuous-time at use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks 			
Personal Competence				
Social Competence	Students can work in small groups to joint	tly solve technical problems, and e	xperimental	ly validate the
	controller designs Students can obtain information from experiment guides) and use it when solvir	provided sources (lecture notes		
Autonomy	They can assess their knowledge in week	y on-line tests and thereby control	their learnir	ng progress.
Workload in Use	Independent Study Time 124 Study T	in Locture 56		
Credit points	Independent Study Time 124, Study Time	In Lecture 56		
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German pro Bioprocess Engineering: Core qualification Computer Science: Specialisation Comput Data Science: Core qualification: Elective Electrical Engineering: Core qualification: Energy and Environmental Engineering: C General Engineering Science (English p Compulsory General Engineering Science (English Compulsory General Engineering Science (English pr Compulsory General Engineering Science (English pr Compulsory	n: Compulsory cational Mathematics: Elective Com Compulsory Compulsory fore qualification: Compulsory program, 7 semester): Specialisa program, 7 semester): Specia	pulsory tion Electric lisation Civ	al Engineerin il Engineerin

	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,
Assignment for the	Focus Aircraft Systems Engineering: Compulsory
Following Curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core gualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory
	Process Engineering: Core qualification: Compulsory

Course 0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
_	 Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	
Content	Signals and systems
	Software tools Introduction to Matlab, Simulink, Control toolbox
Literature	 Computer-based exercises throughout the course Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems		
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
Computer Engineering (L03	21)		Lecture	3	4
Computer Engineering (L03	24)		Recitation Section (small)) 1	2
Module Responsible					
Admission Requirements	NODA				
Recommended	Basic knowledge in ele	ectrical engineering			
Previous Knowledge		C. II	and the states for the state states and a		
Professional		essiully, students hav	re reached the following learning	g results	
Competence					
Knowledge	from the assembly-lev Introduction Combinational combinational r Sequential logic Technological fo	el programming dow logic: Gates, Boo networks :: Flip-flops, automata pundations	the functionality of computing n to gates. The module includes lean algebra, Boolean func a, systematic hardware design	the following	topics:
	 Basics of compute Memories: Memories: Memories:	uter architecture: Pro hory hierarchies, SRAI O from the perspec	on, subtraction, multiplication ar gramming models, MIPS single- M, DRAM, caches tive of the CPU, principles of	cycle architec	
	internal structure and highly specific and i components. They are	the physical compo- ndividual computers e able to distinguish	s from the architect's perspectives of computer systems. The can be built based on a construction between and to explain the did circuits up to complete process.	e students ca ollection of fe ifferent abstra	in analyze, he ew and simp
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 sha 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 s	olve similar problems	alone or in a group and to pres	ent the result	s accordingly
			lge from specific literature and		
Workload in Hours	Independent Study Tir	ne 124, Study Time i	n Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus	Form Excorcisos	Description		
Examination	Yes 10 %	Excercises			
Examination duration					
and scale	90 minutes, contents o	of course and labs			
	General Engineering Compulsory	Science (German	program, 7 semester): Specia	alisation Com	puter Scienc
	General Engineering	Science (German pro	ogram, 7 semester): Specialisa	tion Bioproce	ss Engineerin
	Compulsory General Engineering	Science (German g	program, 7 semester): Specia	lisation Nava	al Architectu
	Compulsory		ogram, 7 semester): Specialis		
	Compulsory				5
	General Engineering S Compulsory	Science (German pro	ogram, 7 semester): Specialisa	tion Biomedic	al Engineerin
			gram, 7 semester): Specialisati	on Energy an	d Enviroment
	General Engineering		rogram, 7 semester): Speciali	isation Proces	ss Engineerin
	Compulsory				
	General Engineering S Focus Mechatronics: C		ogram, 7 semester): Specialisat	tion Mechanic	al Engineerin

I I	
	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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Data Science: Core qualification: Elective Compulsory
r ononing curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory Constructions (Eaclish groups 7 constants), Cassislication Civil, Environment
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	5 5 1 5
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
-	Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

Course L0324: Compute	urse 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 M0599: II	ntegrated Produ	ict Developmen	t and Lightweight D	esign		
Courses						
Title			Тур	Hrs/wk	СР	
CAE-Team Project (L0271)			Project-/problem-based	2	2	
Development of Lightweigh	t Design Products (L0270)	Learning Lecture	2	2	
Integrated Product Develop	ment I (L0269)		Lecture	2	2	
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
	Advanced Knowledge	about engineering desig	n:			
	Fundamentals of Mech	anical Engineering Desi	gn			
Recommended Previous Knowledge	Mechanical Engineerin	a: Desian	-			
ricenous knowledge						
	Advanced Mechanical	Engineering Design				
	After taking part succe	essfully, students have r	eached the following learning	results		
Professional Competence						
		nodule, students are cap	able of:			
Knowledge	 explaining the f 	unctional principle of 3D	-CAD-Systems, PDM- and FEI	4-Systems		
			nt CAE-Systems in the produc		ent process	
	After completing the n	nodule, students are abl	e to:			
	, and completing the h					
Skills						
Skiiis	 evaluate difference 	ent CAD- and PDM-Syst hemes and product stru	ems with regards to the de cturing	sired require	ements such a	
	 design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload 					
Personal Competence						
		nodule, students are abl	e to:			
Cosial Compotance	To develop a project plan and allocate work appropriate work packages in the framework of					
Social Competence	group discussions					
	Present project results as a team for instance in a presentation					
	Students are capable of	of:				
Autonomy	 independently adapt to a CAE-Tool and complete a given practical task with it 					
Workload in Hours	Independent Study Tin	ne 96, Study Time in Le	ture 84			
Credit points						
	Compulsor B onus	Form	Description			
Course achievement	Yes 20 %	Subject theoretical practical work	^{and} CAE-Teamprojekt inkl.	Vortrag und	Ausarbeitung	
Examination	Written exam					
Examination duration						
and scale						
			am, 7 semester): Specialisat	ion Mechani	cal Engineering	
Assignment for the Following Curricula	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,					
	Focus Product Development and Production: Compulsory Engineering Science: Specialisation Mechanical Engineering: 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: Elective Compulsory					
	Mechanical Engineering: Specialisation Product Development and Production: Compulsory					
	Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Product Development, Materials and Production: Technical Complementary Course Core Studies:					
	Elective Compulsory	,	common compiciliti			

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

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

ırse L0269: Integrat	ed 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	 Introduction to Integrated Product Development 3D CAD -Systems and CAD interfaces Administration of part lists / PDM systems PDM in different industries Selection of CAD-/PDM Systems Simulation Construction methods Design for X
Literature	 Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Aircraft Sy		Lecture	2	2
Fundamentals of Aircraft Sy		Recitation Section (small)	1	1
Air Transportation Systems Air Transportation Systems		Lecture Recitation Section (large)	2 1	2 1
Module Responsible		Recitation Section (large)	1	1
Admission				
Requirements				
Recommended Previous Knowledge	Basics of mathematics, mechanics and th	ermodynamics		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning	results	
Professional Competence				
Knowledge	Students get a basic understanding of the structure and design of an aircraft, as well as an overview the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key paramete 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 syste concepts and their technical system implementation. In addition, they can apply the learned metho for the design and assessment of subsystems of the air transportation system in the context of t overall system.			
Personal Competence				
Social Competence	Students are made aware of interdisciplinary communication in groups.			
Autonomy	Students are able to independently analyze different system concepts and their technic implementation as well as to think system oriented.			
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	150 min			
	General Engineering Science (German 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: Fundam	entals of Aircraft Systems			
Тур	Lecture			

Тур	Lecture		
Hrs/wk	2		
СР			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	of. Frank Thielecke		
Language	DE		
Cycle	SoSe		
Content	 Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems 		
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 Tran	sportation Systems	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Volker Gollnick	
Language	DE	
Cycle	SoSe	
Content	 Air transport as part of the global transportation system Legal basis of air transportation Safety and security aspects Aircraft basics The role of the aircraft amnufacturer The role of the aircraft operator Airport operation The principles of air traffic management Environmental aspects of air transportation Future perspectives of air transport 	
Literature	 V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5 D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4 P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8 H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0 	

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

Courses				
Title Management Tutorial (L088 Introduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof Christoph Ibl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence	After taking this module, students know the im	portant basics of many diffe	arent areas	in Business ar
Knowledge	 Management, from Planning and Organisation to Controlling. In particular they are able to explain the differences between Ecore Management and to name important define explain the most important aspects of a aspects of entreprneurial projects describe and explain basic business function management, organization and hu innovation management and marketing explain the relevance of planning and multiple objectives and uncertainty, a Finance state basics from accounting and costing 	o Marketing and Innovation, nomics and Management a initions from the field of Man nd goals in Management and ctions as production, procure man ressource management decision making in Busines nd explain some basic me and selected controlling me	and also to and the su agement d name the ement and s c, informatio as, esp. in s ethods from thods.	Investment ar b-disciplines most importa ourcing, supp n managemer ituations und n mathematic
Skills	Students are able to analyse business units wirstrategies etc.) and to carry out an Entrepreneut analyse Management goals and structure analyse organisational and staff structure apply methods for decision making under analyse production and procurement syst analyse and apply basic methods of mark select and apply basic methods from mark apply basic methods from accounting, co	rship project in a team. In pa e them appropriately es of companies r multiple objectives, under u tems and Business informati keting thematical finance to predefi	articular, the uncertainty a on systems ned problem	y are able to and under risk
Personal Competence				
Social Competence	 Students are able to work successfully in a team of students to apply their knowledge from the lectu report on the project to communicate appropriately and to cooperate respectfully with their fellow 		roject and v	vrite a cohere
Autonomy	Students are able towork in a team and to organize the teamto write a report on their project.	themselves		
Workload in Hours	Independent Study Time 110, Study Time in Leo	cture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, Civil- and Environmental Engineering: Core qual Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Com Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Comp Energy and Environmental Engineering: Core qualification: Comp	lification: Compulsory ation Civil Engineering: Electi ation Water and Environment ation Traffic and Mobility: Ele apulsory ory ulsory	ve Compuls : Elective Co	ory ompulsory

I.	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	
y	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
l	Process Engineering: Core qualification: Compulsory

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

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

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.

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Courses				
Title	poring Design II (10264)	Typ Lecture	Hrs/wk 2	CP 2
Advanced Mechanical Engineering Design II (L0264) Advanced Mechanical Engineering Design II (L0265)		Recitation Section (large)	2	1
Advanced Mechanical Engineering Design I (L0203) Advanced Mechanical Engineering Design I (L0262)		Lecture	2	2
Advanced Mechanical Engin	eering Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	 Fundamentals of Mechanical En Mechanics Fundamentals of Materials Scient Production Engineering 			
Educational Objectives	After taking part successfully, students	s have reached the following learning	results	
Professional Competence	After passing the module, students are	a able to:		
Knowledge	 explain complex working principluidics, 	ples and functions of machine elemer criteria, application scenarios and pra		
Skills	 transfer knowledge learned in skills), 	ations of covered machine elements, the module to new requirements a cal drawings and schematic sketches,	and tasks (oroblem solvin
Personal Competence				
Social Competence	 Students are able to discuss methods. 	technical information in the lectur	e supporte	d by activatin
Autonomy		ntly deepen their acquired knowledge ditional knowledge and to recapitulate gs of the lectures.		
Workload in Hours	Independent Study Time 68, Study Tin	ne in Lecture 112		
Credit points				
Course achievement				
Examination				
Examination duration and scale	120			
	General Engineering Science (German Focus Aircraft Systems Engineering: C General Engineering Science (German Focus Materials in Engineering Science General Engineering Science (German Focus Mechatronics: Compulsory General Engineering Science (German Focus Product Development and Produ General Engineering Science (German Focus Theoretical Mechanical Enginee General Engineering Science (German	ompulsory n program, 7 semester): Specialisati es: Compulsory n program, 7 semester): Specialisati n program, 7 semester): Specialisati uction: Compulsory n program, 7 semester): Specialisati ring: Compulsory	on Mechani on Mechani on Mechani on Mechani	cal Engineering cal Engineering cal Engineering cal Engineering

	Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Following Curricula	Energy Systems: Technical Complementary Course Core Studies: Elective 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

ourse L0264: Advance	ed Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
.,	Advanced Mechanical Engineering Design I & II
	Lecture
	• Fundamentals of the following machine elements:
	Linear rolling bearings
	• Axes & shafts
	 Seals Clutches & brakes
	Belt & chain drives
	• Gear drives
	 Epicyclic gears
	Crank drives
Content	Sliding bearings
Content	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	 Linear rolling bearings
	 Axes & shafts
	 Clutches & brakes
	Belt & chain drives
	Gear drives Friendle second
	 Epicyclic gears Crank gears
	 Sliding bearings
	Calculations of hydrostatic systems (fluidics)
	 Dubbel, Taschenbuch f ür den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Ver
	aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktu
	Auflage.
1 1 • • • • • • • • • • • • • • • • • • •	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
Literature	 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,
	Springer-Verlag, aktuelle Auflage.
	 Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer View
	aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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

rse L0262: Advance	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II Lecture • 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 • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Gear drives • Crank gears
Literature	 Sliding bearings Calculations of hydrostatic systems (fluidics) 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, aktuell Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg aktuelle Auflage.

Typ Recitation Section (large)	
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432		Lecture	3	4
Signals and Systems (L0433		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of signals by the moduls Mathematik 1-3 is expected. Further series, Fourier transform, Laplace transform) is usef	r experience with spectr		
ducational Objectives	After taking part successfully, students have reache	d the following learning r	esults	
Professional				
Competence Knowledge	The students are able to classify and describe sig methods of signal and system theory. They are a continuous-time and discrete-time signals and syst signals and systems mathematically in both time ar effects in time domain and image domain which signal to a discrete-time signal.	able to apply the funda cems. They can describe nd image domain. In part are caused by the trans	mental tran and analys icular, they sition of a o	nsformations se determinis understand t continuous-tir
Skills	The students are able to describe and analyse determining methods of signal and system theory. They important properties such as magnitude and phase the impact of LTI systems on the signal properties in	can analyse and desigr response, stability, line	n basic syst arity etc T	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant informa control their level of knowledge during the lecture clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Focus Biomechanics: Compulsory General Engineering Science (German program, 7 Focus Energy Systems: Compulsory General Engineering Science (German program, 7 Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7	7 semester): Specialis 7 semester): Specialisation semester): Specialisation semester): Specialisation semester): Specialisation semester): Specialisation	sation Com ation Proces on Bioproce on Biomedic n Mechanic n Mechanic n Mechanic	aputer Scien ss Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin
Assignment for the Following Curricula	Focus Materials in Engineering Sciences: Compulsor General Engineering Science (German program, 7 Focus Mechatronics: Compulsory General Engineering Science (German program, 7 Focus Theoretical Mechanical Engineering: Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering Science (English program, 7 Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory	y semester): Specialisatio ory 7 semester): Specialisat 7 semester): Specialisat 7 semester): Specialisa	n Mechanic n Mechanic ion Electric sation Com ition Proces	cal Engineerin cal Engineerin cal Engineerin oputer Science ss Engineerin

Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Biomechanics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Energy Systems: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Aircraft Systems Engineering: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Materials in Engineering Sciences: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Mechatronics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Theoretical Mechanical Engineering: Compulsory		
Computational Science and Engineering: Core qualification: Compulsory		
Mechatronics: Core qualification: Compulsory		
Technomathematics: Specialisation III. Engineering Science: Elective Compulsor	ry	

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

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

Module M0988: S	tructural Materials			
Courses				
Title Fundamentals of Mechanica Welding Technology (L1123	l Properties of Materials (L1090))	Typ Lecture Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Materials Science			
Educational Objectives	After taking part successfully, students ha	ve reached the following lea	arning results	
Professional Competence		had a second second to be found to		·
Knowledge	The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowlegde in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dynamic loads. The students get to know the most important welding technologies and the corresponding systems. They learn about the influence of welding on the materials and design.			
Skills	The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding behaviour of steel materials. The students are able to select between alloys according to the desired mechaincal properties and welability. They can distinguish between different welding techniques and select the suitable technique and system components for a defined application. They are able to dimension weld joints within design tasks.			properties and table technique
Personal Competence				
Social Competence				
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German pr Focus Materials in Engineering Sciences: C General Engineering Science (English pro Focus Materials in Engineering Sciences: C Mechanical Engineering: Specialisation Ma	Compulsory ogram, 7 semester): Speci Compulsory	alisation Mechanic	

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

diagrams - properties of weldable carbon and fine grained steels - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding - resistance welding/ polymer welding/ hybrid-welding - deposition welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005.	ourse L1123: Welding	Technology
COP 3 Workload in Hours Independent Study Time 48, Study Time in Lecture 42 Lecturer Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer Language DE Cycle WiSe - phase transitions, phase diagrams and thermal activated processes - fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams - properties of weldable carbon and fine grained steels - properties of weldable carbon and fine grained steels - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steel: - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schuize, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechologien, 3. Aufl., Berlin 2006. </th <th>Тур</th> <th>Lecture</th>	Тур	Lecture
Workload in Hours independent Study Time 48, Study Time in Lecture 42 Lecturer Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer Language DE Cycle WiSe - phase transitions, phase diagrams and thermal activated processes - fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams - properties of weldable carbon and fine grained steels - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steel - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding - electron beam welding/ laser beam welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dithey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß Bilthey, U.: Schweißtechn	Hrs/wk	3
Lecturer Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer Language DE Cyctel WiSe - phase transitions, phase diagrams and thermal activated processes - fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams - properties of weldable carbon and fine grained steels - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steel: - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas marc welding (MAG)/Plasma Welding - resistance welding/ polymer welding/ hybrid-welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schueißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.	СР	3
Language DE Cycle WiSe - phase transitions, phase diagrams and thermal activated processes - fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams - properties of weldable carbon and fine grained steels - properties of weldable carbon and fine grained steels - properties of weldable carbon and high-alloy steels, corrosion resistant steels and high-strength steel: - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding - resistance welding/ polymer welding/ hybrid-welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß Literature Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit	Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Cycle WiSe - phase transitions, phase diagrams and thermal activated processes - fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams - properties of weldable carbon and fine grained steels - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steel - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweißtechnise Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß Bithey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeir	Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
 phase transitions, phase diagrams and thermal activated processes phase transitions, phase diagrams and thermal activated processes fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams properties of weldable carbon and fine grained steels properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steel: structure and properties of non-ferrite metals (aluminum, titanium) NDT/DT Methods for materials and welds gas fusion welding, fundamentals of electric arc welding technologies content structure and influence parameters for the welded joint stubmerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding resistance welding/ polymer welding/ hybrid-welding deposition welding electron beam welding/ laser beam welding weld joint designs and declarations computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechniss Fertigungsverfahren, Bd. 1: Schweißtechniss Fertigungsverfahren, Bd. 1: Schweißtechnisch Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß Juithey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit 	Language	DE
 - fundamentals of steels, heat treatment applications for steels and time temperature transforma diagrams - properties of weldable carbon and fine grained steels - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels - structure and properties of non-ferrite metals (aluminum, titanium) - NDT/DT Methods for materials and welds - gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas m arc welding (MAG)/Plasma Welding - deposition welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit 	Cycle	
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 NDT/DT Methods for materials and welds gas fusion welding, fundamentals of electric arc welding technologies structure and influence parameters for the welded joint submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas marc welding (MAG)/Plasma Welding resistance welding/ polymer welding/ hybrid-welding deposition welding electron beam welding/laser beam welding weld joint designs and declarations computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 		- properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels
- gas fusion welding, fundamentals of electric arc welding technologies - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas marc welding (MAG)/Plasma Welding - resistance welding/ polymer welding/ hybrid-welding - deposition welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechniss Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit		
Content - structure and influence parameters for the welded joint - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas marc welding (MAG)/Plasma Welding - resistance welding/ polymer welding/ hybrid-welding - deposition welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechniss Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit		- NDT/DT Methods for materials and weids
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 - deposition welding - electron beam welding/ laser beam welding - electron beam welding/ laser beam welding - weld joint designs and declarations - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechniss Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit 1. 		- submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas meta arc welding (MAG)/Plasma Welding
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 - computation methods for weld joint dimensioning Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißtechnische Schweißtec		- electron beam welding/ laser beam welding
Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnis Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Literature Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweiß 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit		- weld joint designs and declarations
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Literature 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit		
	Literature	3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit vo

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
		Recitation Section (smail)	Z	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in	n time and frequency domain, Lapla	ce transform	
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence		<u>_</u>		
Knowledge	 Students can represent dynamic particular explain properties of fir They can explain the dynamics of of frequency response and root lo They can explain the Nyquist state They can explain the role of the p They can explain the way a PII response They can explain issues arising implemented digitally 	st and second order systems simple control loops and interpret cus bility criterion and the stability marg hase margin in analysis and synthe D controller affects a control loop	dynamic prop ins derived f sis of control in terms o	perties in tern rom it. loops f its frequend
Skills	 Students can transform models of vice versa They can simulate and assess the They can design PID controllers w They can analyze and synthesize response techniques They can calculate discrete-time use it for digital implementation They can use standard software tasks 	behavior of systems and control lo ith the help of heuristic (Ziegler-Nic simple control loops with the help approximations of controllers desig	ops hols) tuning of root locus ned in conti	rules and frequen nuous-time ai
Personal Competence				
Social Competence	Students can work in small groups to joi controller designs	ntly solve technical problems, and e	experimental	ly validate the
	Students can obtain information from experiment guides) and use it when solv	provided sources (lecture notes		
Autonomy	They can assess their knowledge in wee	kly on-line tests and thereby contro	l their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German p Bioprocess Engineering: Core qualificatio Computer Science: Specialisation Compu Data Science: Core qualification: Elective Electrical Engineering: Core qualification Energy and Environmental Engineering: General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English Compulsory	on: Compulsory utational Mathematics: Elective Com e Compulsory I: Compulsory Core qualification: Compulsory program, 7 semester): Specialisa n program, 7 semester): Specia	npulsory tion Electric Ilisation Civ	al Engineerin il Engineerin

	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
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	Focus Aircraft Systems Engineering: Compulsory
i onoming curriculu	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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 gualification: Compulsory
	Trocess Engineering. Core quainedation. Compaisory

Course 0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
~	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
	Signals and systems
	 Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability
	Feedback systems
	 Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle
	 Root locus techniques Root locus plots
	Root locus design of PID controllers Frequency response techniques
Content	 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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 M1009: M	laterial Science Laborator	,		
Courses				
Title Companion Lecture for Mate Material Science Laboratory	erials Science Laboratory (L1088) / (L1235)	Typ Lecture Practical Cours	Hrs/wk 2 se 4	CP 2 4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	NODA			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students	have reached the following	ng learning results	
Professional Competence				
Knowledge	Students are able to give a summary of the technical details of experiments in the area of material 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 solvin practical problems. They identify and overcome typical problems during the realization of experiment in the context of material sciences.			
Personal Competence				
Social Competence	Students are able to cooperate in sr materials sciences. They are able to e front of a qualified audience.			
Autonomy	Students are capable of solving proble They are able to fill gaps in as well a provided by the supervisor.			
Workload in Hours	Independent Study Time 96, Study Tim	ne in Lecture 84		
Credit points	6			
Course achievement	None			
	Written exam			
Examination duration and scale	1,5 h written Exam (50%) covering the	lesson		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory			

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Numerical Mathematics I (L	0417)	Lecture	2	3	
Numerical Mathematics I (L	0418)	Recitation Section (small)	2	3	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	 Mathematik I + II for Engineering Stud for Technomathematicians basic MATLAB knowledge 	ents (german or english) or Ana	alysis & Line	ar Algebra I +	
Educational Objectives	After taking part successfully, students have	reached the following learning	results		
Professional					
Competence					
	Students are able to				
Knowledge	 name numerical methods for interpolation, integration, least squares problems, eigenvalu problems, nonlinear root finding problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx. 				
	Students are able to				
Skills	 implement, apply and compare nume justify the convergence behaviour of solution algorithm, select and execute a suitable solution 	of numerical methods with res	spect to the	e problem an	
Personal Competence					
	Students are able to				
Social Competence	 work together in heterogeneously composed teams (i.e., teams from different study program and background knowledge), explain theoretical foundations and support each other w practical aspects regarding the implementation of algorithms. 				
	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	6				
Course achievement	None				
Examination					
Examination duration	90 minutes				
and scale	General Engineering Science (German p	ogram 7 comester): Speciali	sation Com	nuter Science	
	Compulsory General Engineering Science (German prog Focus Materials in Engineering Sciences: Cor General Engineering Science (German prog Compulsory General Engineering Science (German prog Focus Biomechanics: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: C Bioprocess Engineering: Specialisation A - G Computer Science: Specialisation Computati	ram, 7 semester): Specialisatic npulsory ram, 7 semester): Specialisatic ram, 7 semester): Specialisatic ram, 7 semester): Specialisatic ompulsory eneral Bioprocess Engineering: E onal Mathematics: Elective Com	on Mechanic on Biomedic on Mechanic on Mechanic Elective Com pulsory	al Engineering al Engineering al Engineering al Engineering pulsory	
Assignment for the Following Curricula	Computer Science: Specialisation II. Mathem Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Elec Engineering Science: Core qualification: Com General Engineering Science (English prog Focus Theoretical Mechanical Engineering: E General Engineering Science (English progra General Engineering Science (English progra	, ctive Compulsory pulsory ram, 7 semester): Specialisatic lective Compulsory m, 7 semester): Core qualification	on Mechanic on: Compuls	al Engineering	

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Biomechanics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engine	eering:
Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	
Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: E	lective
Compulsory	
Process Engineering: Specialisation Process Engineering: Elective Compulsory	

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

Course L0418: Numerical Mathematics I		
Recitation Section (small)		
2		
3		
Independent Study Time 62, Study Time in Lecture 28		
Prof. Sabine Le Borne, Dr. Jens-Peter Zemke		
EN		
WiSe		
See interlocking course		
See interlocking course		

Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L03 Computer Engineering (L03			Lecture Recitation Section (small)	3 1	4 2
Module Responsible	1		Reclation Section (small)	Ŧ	Z
Admission Requirements					
Requirements					
Recommended Previous Knowledge	Basic knowledge in ele	ectrical engineering			
ducational Objectives	After taking part succe	essfully, students have	e reached the following learning	g results	
Professional Competence					
	from the assembly-lev Introduction Combinational n Sequential logic Technological fo Computer arithr Basics of compu Memories: Mem Input/output: I// connections, bu The students perceiv internal structure and highly specific and in components. They are today's computing sys After successful comp between a physical of	el programming dowr logic: Gates, Bool setworks :: Flip-flops, automata oundations metic: Integer addition iter architecture: Prog ory hierarchies, SRAM O from the perspect sses e computer systems the physical compos ndividual computers e able to distinguish tems - from gates and oletion of the modul computer system an	the functionality of computing solutions in the gates. The module includes the gates. The module includes the gates. The module includes and algebra, Boolean function, systematic hardware design in, subtraction, multiplication an gramming models, MIPS single-of the group of the CPU, principles of from the architect's perspective of the CPU, principles of the computer systems. The can be built based on a complete model of circuits up to complete processe, the students are able to jud the software executed on cution of software has on the complete processe.	the following tions, hardw d division cycle architec passing data tive, i.e., th e students ca illection of fi fferent abstra- sors. udge the intu- it. In particu	topics: are synthesi ture, pipelining , point-to-poin ey identify th n analyze, ho ew and simp action layers o erdependencie ular, they sha
	impact that these lov feasible options. Students are able to so	v abstraction levels blve similar problems	to gates. This way, they will have on an entire system's p alone or in a group and to pres ge from specific literature and	erformance a	and to propos s accordingly.
Workload in Hours	Independent Study Tin	ne 124, Study Time in	Lecture 56		
Credit points					
Course achievement	CompulsorBonus Yes 10 %	Form Excercises	Description		
Examination	Written exam				
Examination duration and scale	90 minutes, contents o	of course and labs			
	Compulsory General Engineering S Compulsory General Engineering Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulsor	Science (German pro Science (German p Science (German pro Science (German pro Science (German prog Science (German prog	rogram, 7 semester): Specia gram, 7 semester): Specialisat rogram, 7 semester): Specia ogram, 7 semester): Specialisat gram, 7 semester): Specialisati ogram, 7 semester): Specialisati	tion Bioproce lisation Nava ation Electric tion Biomedic on Energy an	ss Engineering al Architectur al Engineerin al Engineerin d Enviroment

	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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Data Science: Core qualification: Elective Compulsory
i ononing curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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	 Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output 	
Literature	 A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. 	

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

Courses				
litle		Тур	Hrs/wk	СР
	eramics and Polymers (L1233)	Lecture	2	2
	eramics and Polymers (L1234)	Recitation Section (large)	1	1
Enhanced Fundamentals: Mo	etals (L1086)	Lecture	2	3
Module Responsible				
Admission Requirements	None			
	Module "Fundamentals of Materials So	tience"		
Recommended Previous Knowledge	Module "Materials Science Laboratory	п		
	Module "Advanced Materials"			
ducational Objectives	After taking part successfully, student	s have reached the following learning	results	
Professional Competence				
	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 , electri and mass transport, microstructure and phase diagrams. They are capable to explain the correspond technical terms.			
Skills	The students are able to apply th mentioned subjects.	e appropriate physical and chemica	il methods f	for the abo
Personal Competence				
Social Competence				
Autonomy	The students are capable to understa and polymers. They should be able to	nd independently the structure and pr critally evaluate the profoundness of t		
Workload in Hours	Independent Study Time 110, Study T	ime in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula				

Course L1233: Enhance	ed Fundamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner
Language	DE/EN
Cycle	SoSe
	1. Einführung Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik

	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik Sprühtrockner
	3. Formgebung
	Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte)
Content	4. Sintern
	Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften Anwendungen
	Keramische Ionenleiter
	lonische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
	W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998
	D. Munz, T. Fett, Ceramics, Springer, 2001
Literature	
	Polymerwerkstoffe Struktur und mechanische Eigenschaften G.W.Ehrenstein; Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	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 €

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

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

Courses				
Title Management Tutorial (L088 Introduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence	After taking this module, students know the im	portant basics of many diffe	erent areas	in Business a
Knowledge	 Management, from Planning and Organisation to Controlling. In particular they are able to explain the differences between Econ Management and to name important define explain the most important aspects of ar aspects of entreprneurial projects describe and explain basic business func chain management, organization and hur innovation management and marketing explain the relevance of planning and or multiple objectives and uncertainty, ar Finance state basics from accounting and costing 	omics and Management a nitions from the field of Man nd goals in Management an ctions as production, procure man ressource management decision making in Busines nd explain some basic me and selected controlling me	and the su agement d name the ement and s c, informatio as, esp. in s ethods from thods.	b-disciplines most importa courcing, supp n managemen ituations und n mathematic
Skills	Students are able to analyse business units wit strategies etc.) and to carry out an Entrepreneur analyse Management goals and structure analyse organisational and staff structure apply methods for decision making under analyse production and procurement syst analyse and apply basic methods of mark select and apply basic methods from mat apply basic methods from accounting, cos	rship project in a team. In pa them appropriately s of companies multiple objectives, under u tems and Business informati teting hematical finance to predefi	articular, the uncertainty a on systems ned problem	y are able to and under risk as
Personal Competence				
Social Competence	 Students are able to work successfully in a team of students to apply their knowledge from the lectur report on the project to communicate appropriately and to cooperate respectfully with their fellow 		roject and v	ırite a cohere
Autonomy	 Students are able to work in a team and to organize the team to write a report on their project. 	themselves		
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, Civil- and Environmental Engineering: Core quali Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Com Computer Science: Core qualification: Compulso Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compu Energy and Environmental Engineering: Core qu	ification: Compulsory Ition Civil Engineering: Electi Ition Water and Environmeni Ition Traffic and Mobility: Ele pulsory Iry	ve Compuls : Elective Co	ory ompulsory

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	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	Focus Energy Systems: Compulsory
5	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
· · · · · · · · · · · · · · · · · · ·	Process Engineering: Core qualification: Compulsory

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

_ 1			
	Lecture		
Hrs/wk			
СР			
	ndependent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language			
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Sup Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Ch Management, Information Management Definitions as information, information systems, aspects of data security and strate information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects 		
Literature	 Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftsleh Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. 		

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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.

Module M0597: A	Advanced Mechanical Engineeri	ng Design		
Courses				
Title Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin Advanced Mechanical Engin	neering Design II (L0265) neering Design I (L0262)	Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 2 2 2	CP 2 1 2 1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge		ng Design		
Educational Objectives	After taking part successfully, students have r	reached the following learning	results	
Professional Competence				
Knowledge	 After passing the module, students are able to explain complex working principles and fluidics, explain requirements, selection criteria machine elements, indicate the background of dimensionir 	d functions of machine elemer , application scenarios and pra		
Skills	 After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. 			
Personal Competence Social Competence	Students are able to discuss technic	cal information in the lectur	e supported	d by activating
Autonomy	 Students are able to independently dee Students are able to acquire additional e.g. by using the video recordings of th 	knowledge and to recapitulate		
Workload in Hours	Independent Study Time 68, Study Time in Le	cture 112		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	120			
	General Engineering Science (German progr Focus Aircraft Systems Engineering: Compulse General Engineering Science (German progr Focus Materials in Engineering Sciences: Com General Engineering Science (German progr Focus Mechatronics: Compulsory General Engineering Science (German progr Focus Product Development and Production: C General Engineering Science (German progr Focus Theoretical Mechanical Engineering: Co General Engineering Science (German progr Focus Biomechanics: Compulsory General Engineering Science (German progr Focus Biomechanics: Compulsory General Engineering Science (German progr	ory am, 7 semester): Specialisatio pulsory am, 7 semester): Specialisatio am, 7 semester): Specialisatio Compulsory am, 7 semester): Specialisatio mpulsory am, 7 semester): Specialisatio	on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic	cal Engineering, cal Engineering, cal Engineering, cal Engineering, cal Engineering,
	[407]			

Assignment for the	Focus Energy Systems: Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory	I
Following Curricula	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	1
	Mechanical Engineering: Core qualification: Compulsory	
	Naval Architecture: Core qualification: Compulsory	1

Course L0264: Advanced Mechanical Engineering Design II				
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff			
Language	DE			
Cycle	SoSe			
	Advanced Mechanical Engineering Design I & II			
Content	Lecture			
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg aktuelle Auflage. 			

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

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

Courses				
Title Signals and Systems (L0432		Typ Lecture	Hrs/wk	CP 4
Signals and Systems (L0432		Recitation Section (small)		4 2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of sign by the moduls Mathematik 1-3 is expected. Fur- series, Fourier transform, Laplace transform) is u	ther experience with spectr		
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe methods of signal and system theory. They are continuous-time and discrete-time signals and s signals and systems mathematically in both time effects in time domain and image domain whice signal to a discrete-time signal.	re able to apply the funda systems. They can describe a and image domain. In part ch are caused by the trans	mental tran and analys cicular, they sition of a c	nsformations se determinis understand t continuous-tir
Skills	The students are able to describe and analyse of using methods of signal and system theory. The important properties such as magnitude and phe the impact of LTI systems on the signal properties	ney can analyse and designate as a second analyse and designate as a second as a second as a second as a second	n basic syst arity etc T	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant infor control their level of knowledge during the lectu clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
	General Engineering Science (German program	n, 7 semester): Specialisat	ion Electric	
	Compulsory General Engineering Science (German progra	am, 7 semester): Speciali		-
	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory	m, 7 semester): Specialisa	sation Com ation Proce	nputer Scien ss Engineerir
	General Engineering Science (German progra Compulsory General Engineering Science (German progra	m, 7 semester): Specialisa , 7 semester): Specialisatio	sation Com ation Proce: on Bioproce	nputer Scient ss Engineerin ss Engineerin
	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program	m, 7 semester): Specialisa , 7 semester): Specialisatio , 7 semester): Specialisatio	sation Com ation Proces on Bioproce on Biomedic	nputer Scient ss Engineerin ss Engineerin cal Engineerin
	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	m, 7 semester): Specialisa , 7 semester): Specialisatio , 7 semester): Specialisatio , 7 semester): Specialisatio	sation Com ation Proces on Bioproce on Biomedic on Mechanic	nputer Scient ss Engineerin ss Engineerin cal Engineerin cal Engineerin
	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Energy Systems: Compulsory General Engineering Science (German program Focus Energy Systems: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory	m, 7 semester): Specialisa , 7 semester): Specialisatio , 7 semester): Specialisatio , 7 semester): Specialisatio , 7 semester): Specialisatio , 7 semester): Specialisatio	sation Com ation Proces on Bioproce on Biomedic on Mechanic on Mechanic	aputer Scient ss Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin
	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Energy Systems: Compulsory General Engineering Science (German program	m, 7 semester): Specialisa , 7 semester): Specialisatio , 7 semester): Specialisatio sory	sation Com ation Proces on Bioproce on Biomedic on Mechanic on Mechanic on Mechanic	aputer Scien ss Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin
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Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Energy Systems: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Compul General Engineering Science (German program Focus Materials in Engineering Sciences: Compul General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Comp Computer Science: Core qualification: Compulsor Electrical Engineering: Core qualification: Compul General Engineering: Core qualification: Compul General Engineering: Core qualification: Compulsor	m, 7 semester): Specialisa , 7 semester): Specialisatio , 7 semester): Specialisatio sory , 7 semester): Specialisatio sory , 7 semester): Specialisatio sory , 7 semester): Specialisatio y lsory , 7 semester): Specialisatio	sation Com ation Proces on Bioproce on Biomedic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic	aputer Science ss Engineerin ss Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Energy Systems: 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 Materials in Engineering Sciences: Compul General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Comp Computer Science: Core qualification: Compulsor Electrical Engineering Science (English program Compulsory General Engineering Science (English program Compulsory	m, 7 semester): Specialisa , 7 semester): Specialisatio , 7 semester): Specialisatio sory , 7 semester): Specialisatio , 7 semester): Specialisatio y lsory , 7 semester): Specialisatio y sory , 7 semester): Specialisatio y sory , 7 semester): Specialisatio	sation Com ation Proces on Bioproce on Biomedic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic	aputer Scient ss Engineerin ss Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin
Assignment for the Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Focus Biomechanics: Compulsory General Engineering Science (German program Focus Energy Systems: Compulsory General Engineering Science (German program Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program Focus Materials in Engineering Sciences: Compul General Engineering Science (German program Focus Materials in Engineering Sciences: Compul General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Focus Theoretical Mechanical Engineering: Comp Computer Science: Core qualification: Compulsor Electrical Engineering: Core qualification: Compulsor General Engineering Science (English program Compulsory General Engineering Science (English program	m, 7 semester): Specialisation , 7 semester): Specialisation	sation Com ation Proces on Bioproce on Biomedic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic on Mechanic	aputer Scien ss Engineerin ss Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin sal Engineerin

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Biomechanics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Aircraft Systems Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Materials in Engineering Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
 Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

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Module M1320: S	imulation and Design of Mechatro	nic Systems		
Courses				
Title Simulation and Design of Mo Simulation and Design of Mo Simulation and Design of Mo	echatronic Systems (L1823)	Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 1 1	CP 2 2 2
Module Responsible	Prof. Uwe Weltin			
Admission	None			
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory and e	lectrical engineering		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence	Students are able to describe methods and	calculations for design,	modeling,	simulation and
	optimization of mechatronic systems. Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify, simulate and design simple systems and implement those in laboratory conditions.			
Personal Competence				
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 a further			
Workload in Hours	course of study. Independent Study Time 124, Study Time in Lectu	ro 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory Digital Mechanical Engineering: Core qualification: 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 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: Elective Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechanical Engineering: Specialisation: Compulsory			

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

Course L1823: Simulati	urse 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: Simulati	ourse 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 Circuit Theory (L0566) Circuit Theory (L0567)		Typ Lecture Recitation Section (small)	Hrs/wk 3 2	CP 4 2
Module Responsible	Prof Arne Jacob	. , ,		
Admission Requirements				
Recommended Previous Knowledge	Electrical Engineering I and II, Mathematics I and	II		
Educational Obiectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence	Students are able to explain the basic methods	for calculating electrical circ	uits. They k	
Knowledge	series analysis of linear networks driven by periodic signals. They know the methods for transier analysis of linear networks in time and in frequency domain, and they are able to explain the frequence behaviour and the synthesis of passive two-terminal-circuits.			
Skills	The students are able to calculate currents and 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 tim 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	Students work on exercise tasks in small guided groups. They are encouraged to present and discu			
Social Competence	their results within the group.			
Autonomy	The students are able to find out the required methods for solving the given practice problem 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 Lect	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	150 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineer Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineer		cal Engineerin cal Engineerin cal Engineerin ccience: Electi	

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

ourse L0566: Circuit T	leory
	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Arne Jacob
Language	DE
Cycle	WiSe
Content	 Circuit theorems N-port circuits Periodic excitation of linear circuits Transient analysis in time domain Transient analysis in frequency domain; Laplace Transform Frequency behaviour of passive one-ports
Literature	 M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011) M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011) L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011) T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008) R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006) L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005)

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

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 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 ha	ve reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can it particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in term of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain an implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain a vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and freque response techniques They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks 			
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate the controller designs		ly validate the	
	controller designs Students can obtain information from experiment guides) and use it when solvin	provided sources (lecture notes,		
Autonomy	They can assess their knowledge in weekly on-line tests and thereby control their learning progress.		ng progress.	
Warkland in Hours	Independent Study Time 124 Study Time	in Locture EC		
Credit points	Independent Study Time 124, Study Time	In Lecture 56		
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German pro Bioprocess Engineering: Core qualification Computer Science: Specialisation Compute Data Science: Core qualification: Elective (Electrical Engineering: Core qualification: C Energy and Environmental Engineering: Co General Engineering Science (English p Compulsory General Engineering Science (English Compulsory General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory General Engineering Science (English pro Engineering: Compulsory General Engineering Science (English pro	: Compulsory ational Mathematics: Elective Com Compulsory Compulsory ore qualification: Compulsory rogram, 7 semester): Specialisat program, 7 semester): Specialisation ogram, 7 semester): Specialisation	pulsory tion Electric lisation Civ on Bioproces n Energy an	al Engineerir il Engineerir ss Engineerir d Enviromen

	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
Accianment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Eollowing Curricula	Focus Aircraft Systems Engineering: Compulsory
Following curricula	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core gualification: 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 0654: Introduc	tion to Control Systems
	• •
Hrs/wk	2
CP	
-	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	
	 Signals and systems Linear systems, differential equations and transfer functions
	 First and second order systems, poles and zeros, impulse and step response Stability
	Feedback systems
	 Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection
	 Types of feedback, PID control System type and steady-state error, error constants Internal model principle
	Root locus techniques
	 Root locus plots Root locus design of PID controllers
Content	 Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control
	Time delay systems
	 Root locus and frequency response of time delay systems Smith predictor
	Digital control
	 Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Software tools
	 Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010
	R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduc	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			Tum	Hrc/wk	СР
Computer Engineering (L03	21)		Typ Lecture	Hrs/wk 3	СР 4
Computer Engineering (L03	24)		Recitation Section (small) 1	2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	NODE				
•	Basic knowledge in ele	ectrical engineering			
Previous Knowledge					
-		essfully, students hav	ve reached the following learnin	g results	
Professional Competence					
Knowledge	from the assembly-lev Introduction Combinational combinational r Sequential logic Technological fo	el programming dow logic: Gates, Boo networks :: Flip-flops, automat pundations	the functionality of computing on to gates. The module includes plean algebra, Boolean func a, systematic hardware design on, subtraction, multiplication a	s the following tions, hardw	topics:
	 Basics of compute Memories: Memories: Memories 	uter architecture: Pro lory hierarchies, SRA O from the perspec	ogramming models, MIPS single-	cycle architec	
	internal structure and highly specific and i components. They are	the physical compond ndividual computers able to distinguish	as from the architect's perspe osition of computer systems. The s can be built based on a con between and to explain the d and circuits up to complete proce	e students ca ollection of fo ifferent abstra	n analyze, ho ew and simp
Skills	After successful completion of the module, the students are able to judge the interdependenci 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 abstracti- 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 propo feasible options.				
Personal Competence					
- Social Competence	Students are able to s	olve similar problem	s alone or in a group and to pres	sent the result	s accordingly
			dge from specific literature and		
Workload in Hours	Independent Study Tir	ne 124, Study Time	in Lecture 56		
Credit points	6				
Course achievement	Compulsor B onus	Form	Description		
Examination	Yes 10 %	Excercises			
Examination duration					
and scale	90 minutes, contents (of course and labs			
	General Engineering Compulsory	Science (German	program, 7 semester): Speci	alisation Com	puter Scienc
		Science (German pr	ogram, 7 semester): Specialisa	tion Bioproce	ss Engineerin
	Compulsory General Engineering	Science (German	program, 7 semester): Specia	alisation Nava	al Architectu
	Compulsory	·			
	Compulsory		rogram, 7 semester): Specialis		5
	General Engineering Compulsory	Science (German pr	ogram, 7 semester): Specialisa	tion Biomedic	al Engineerin
	General Engineering S		ogram, 7 semester): Specialisat	ion Energy an	d Enviroment
			program, 7 semester): Special	isation Proces	s Engineerin
	C				
	Compulsory General Engineering S Focus Mechatronics: C		ogram, 7 semester): Specialisa	tion Mechanic	al Engineerir

I I	
	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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Data Science: Core qualification: Elective Compulsory
r ononing curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory Constructions (Eaclish groups 7 constants), Cassislication Civil, Environment
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	5 5 1 5
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
-	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Compute	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	 Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output 		
Literature	 A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. 		

Course L0324: Compute	urse 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 Management Tutorial (L088 Introduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Bus	iness		
Educational Objectives	After taking part successfully, students ha	we reached the following learning	results	
Professional Competence				. .
Knowledge	 After taking this module, students know a Management, from Planning and Organisa Controlling. In particular they are able to explain the differences between Management and to name importat explain the most important aspect aspects of entreprneurial projects describe and explain basic busines chain management, organization a innovation management and market explain the relevance of planning multiple objectives and uncertain Finance state basics from accounting and c 	ation to Marketing and Innovation, Economics and Management a nt definitions from the field of Man s of and goals in Management and s functions as production, procure nd human ressource management eting and decision making in Busines hty, and explain some basic me osting and selected controlling me	and also to I and the sub agement d name the r ement and so , information s, esp. in si ethods from thods.	nvestment an o-disciplines i most importar ourcing, suppl n managemen tuations unde mathematica
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 analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 			
Personal Competence				
Social Competence	 Students are able to work successfully in a team of stud to apply their knowledge from the report on the project to communicate appropriately and to cooperate respectfully with their 	lecture to an entrepreneurship p	roject and w	rite a coheren
Autonomy	 Students are able to work in a team and to organize the to write a report on their project. 	team themselves		
		in Lookum 70		
	Independent Study Time 110, Study Time	in Lecture 70		
Credit points Course achievement				
	Subject theoretical and practical work			
Examination duration	several written exams during the semeste	er		
	General Engineering Science (German pro Civil- and Environmental Engineering: Cor Civil- and Environmental Engineering: Spe Civil- and Environmental Engineering: Spe Civil- and Environmental Engineering: Spe Bioprocess Engineering: Core qualification Computer Science: Core qualification: Cor Data Science: Core qualification: Compuls Electrical Engineering: Core qualification: Energy and Environmental Engineering: C	e qualification: Compulsory ecialisation Civil Engineering: Electi ecialisation Water and Environment ecialisation Traffic and Mobility: Ele h: Compulsory npulsory ory Compulsory	ve Compulso : Elective Co	ory mpulsory

1	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	
y	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
1	Process Engineering: Core qualification: Compulsory

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

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

ourses				
'itle emiconductor Circuit Desig emiconductor Circuit Desig		Typ Lecture Recitation Section (small)	Hrs/wk 3	CP 4 2
		Rectation Section (smail)	1	2
Module Responsible Admission Requirements	Prof. Matthias Kuhi			
Requirements	None			
Recommended	Fundamentals of electrical enginee	ring		
	Basics of physics, especially semico	onductor physics		
ducational Objectives	After taking part successfully, stude	ents have reached the following learning	results	
Professional Competence				
Knowledge	 Students are able to explain the functionality of different MOS devices in electronic circuits. Students are able to explain how analog circuits functions and where they are applied. Students are able to explain the functionality of fundamental operational amplifiers and their specifications. Students know the fundamental digital logic circuits and can discuss their advantages and disadvantages. Students have knowledge about memory circuits and can explain their functionality and specifications. Students know the appropriate fields for the use of bipolar transistors. 			
Skills	of electronic circuits. • Students are able to develocircuits.	pecifications of different MOS devices an op different logic circuits and can des vices, operational amplifiers and bipe	ign different	types of logi
Personal Competence				
Social Competence	 Students are able work effici Students working together questions. 	ently in heterogeneous teams. in small groups can solve problems	and answe	er professiona
Autonomy	• Students are able to assess t	heir level of knowledge.		
Workload in Hours	Independent Study Time 124, Study	y Time in Lecture 56		
Credit points	6			
Course achievement				
Examination				
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechatronics: Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Engineering Science: Specialisation Electrical Engineering: Compulsory Engineering Science: Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineerin 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 Mechatronics: 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 Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsory General Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory			

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

ourse L0763: Semicor	nductor 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	
Cycle	SoSe
Content	 Repetition Semiconductorphysics and Diodes Functionality and characteristic curve of bipolar transistors Basic circuits with bipolar transistors Functionality and characteristic curve of MOS transistors Basic circuits with MOS transistors for amplifiers Operational amplifiers and their applications Typical applications for analog and digital circuits Realization of logical functions Basic circuits with MOS transistors for combinational logic Memory circuits Basic circuits with MOS transistors for sequential logic Basic concepts of analog-to-digital and digital-to-analog-converters
Literature	 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 Basic circuits and characteristic curves of bipolar transistors Basic circuits and characteristic curves of MOS transistors for amplifiers Realization and dimensioning of operational amplifiers Realization of logic functions Basic circuits with MOS transistors for combinational and sequential logic Memory circuits Circuits for analog-to-digital and digital-to-analog converters Design of exemplary circuits
Literature	 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Courses				
Differential Equations 2 (Par	tial Differential Equations) (L1043) tial Differential Equations) (L1044) tial Differential Equations) (L1045)	Typ Lecture Recitation Section (small) Recitation Section (large) Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1 1 2 1 1 1	CP 1 1 1 1 1 1 1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1 - III			
•	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	 Students can name the basic concept appropriate examples. Students can discuss logical connections with the illustrating these connections with the They know proof strategies and can response to the strategies are strategies and can response to the strategies are strategie	ections between these concep e help of examples.		
Skills	 Students can model problems in Ma course. Moreover, they are capable o Students are able to discover and studied in the course. For a given problem, the students can critically evaluate the results. 	f solving them by applying estab verify further logical connection	olished methons betwee	ods. n the conce
Personal Competence Social Competence	 Students are able to work together in language. In doing so, they can communicate partners. Moreover, they can design peers. 	new concepts according to the	needs of th	eir cooperat
Autonomy	 Students are capable of checking the can specify open questions precisely Students have developed sufficient proviented manner on hard problems. 	and know where to get help in se	olving them	
Workload in Hours	Independent Study Time 68, Study Time in I	ecture 112		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	rential Equations 2)		
	General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering: E Computer Science: Specialisation Computat Computer Science: Specialisation II. Mathem Electrical Engineering: Core qualification: Core Engineering Science: Specialisation Electricat	gram, 7 semester): Specialisatio rogram, 7 semester): Speciali gram, 7 semester): Specialisatio Elective Compulsory ional Mathematics: Elective Com natics and Engineering Science: I ompulsory	on Mechanic sation Nav on Mechanic pulsory	cal Engineerin al Architectu cal Engineerin

	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:	
	Compulsory	
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:	
Following Curricula	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 II. Mathematics & Engineering Science: Elective	
	Compulsory	
	Mechanical Engineering: Specialisation Mechatronics: Compulsory	
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory	
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective compulsory	
	5 5 7 7	
	Mechatronics: Core qualification: Compulsory	
	Naval Architecture: Core qualification: Compulsory	
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective	
	Compulsory	

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

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

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

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

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

Focus Product Development and Production

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

Module M0597: A	dvanced Mechanical Engi	leering Design		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engin Advanced Mechanical Engin		Lecture Recitation Section (large)	2 2	2 1
Advanced Mechanical Engin		Lecture	2	2
Advanced Mechanical Engin	eering Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	 Fundamentals of Mechanical Er Mechanics Fundamentals of Materials Scie Production Engineering 			
Educational Objectives	After taking part successfully, student	s have reached the following learning	results	
Professional Competence				
Knowledge	fluidics,	ples and functions of machine elements of machine elements and pr		
Skills	 transfer knowledge learned in skills), 	lations of covered machine elements, the module to new requirements cal drawings and schematic sketches,		problem solvir
Personal Competence				
Social Competence	 Students are able to discuss methods. 	technical information in the lectu	re supporte	d by activatin
Autonomy		ently deepen their acquired knowledge Iditional knowledge and to recapitulat ngs of the lectures.		
Workload in Hours	Independent Study Time 68, Study Tir	me in Lecture 112		
Credit points				
Course achievement	None Written exam			
Examination Examination duration				
and scale	120			
	General Engineering Science (Germa Focus Aircraft Systems Engineering: C General Engineering Science (Germa Focus Materials in Engineering Science General Engineering Science (Germa Focus Mechatronics: Compulsory General Engineering Science (Germa Focus Product Development and Produ General Engineering Science (Germa Focus Theoretical Mechanical Engineer	compulsory n program, 7 semester): Specialisati es: Compulsory n program, 7 semester): Specialisati n program, 7 semester): Specialisati uction: Compulsory n program, 7 semester): Specialisati	on Mechani on Mechani on Mechani	cal Engineering cal Engineering cal Engineering
	[4	33]		

	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 Following Curricula	Focus Energy Systems: Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Course L0264: Advance	ed Mechanical Engineering Design II
Тур	Lecture
Hrs/wk	
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	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

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

Course L0262: Advance	d Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Clutches & brakes Belt & chain drives Gear drives Gear drives Sliding bearings Elements of fluidics Exercise Calculation methods of the following machine elements: Calculation methods of the following machine elements: Clutches & brakes Axes & shafts Clutches & brakes Belt & chain drives Gear drives Clutches & brakes Belt & chain drives Clutches & brakes Sliding bearings Sliding bearings Crank gears Sliding bearings Clutches Sliding bearings Clutches Clutches Clutches Sliding bearings Crank gears Clutches Clutch
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

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

Courses				
Title		Тур	Hrs/wk	СР
Production Engineering I (L	0608)	Lecture	2	2
Production Engineering I (L0		Recitation Section (large)	1	1
Production Engineering II (L Production Engineering II (L		Lecture Recitation Section (large)	2 1	2 1
5 5 (·	Recitation Section (large)	1	1
Module Responsible				
Admission Requirements	None			
Recommended	no course assessments required			
	internship recommended			
Educational Objectives	After taking part successfully, students	have reached the following learning	roculto	
Professional		have reached the following learning	results	
Competence				
	Students are able to			
	 name basic criteria for the select 	ion of manufacturing processes.		
	 name the main groups of Manufa 	cturing Technology.		
	 name the application areas of dif 		6	
Knowledge		nd disadvantages of the different man roperties and kinematic variables a		
	workpiece and process.		ina requirer	
	 explain the essential models of m 	nanufacturing technology.		
	Students are able to			
		n accordance with the requirements.		
Skills		s for simple tasks to meet the r	equired tol	erances of t
SKIIIS	component to be produced.	neir production-oriented construction		
			-	
Personal Competence				
	Students are able to			
		on environment with qualified perso	nnel at tech	nnical level a
Social Competence	represent decisions.			
	Students are able to			
	 interpret independently the manual 			
Autonomy	 assess own strengths and weakn assess their learning progress ar 			
, laconomy	 assess their learning progress an assess possible consequences of 			
	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German	program, 7 semester): Specialisatio	on Mechanic	al Engineerir
	Focus Theoretical Mechanical Engineeri	ng: Elective Compulsory		5
	General Engineering Science (German		on Mechanic	al Engineerir
	Focus Product Development and Produc General Engineering Science (English		n Mechanic	al Engineeri
Assignment for the	Eacus Theoretical Mechanical Engineeri			a Ligneell
Following Curricula	General Engineering Science (English	program, 7 semester): Specialisatio	on Mechanic	al Engineerir
	Focus Product Development and Produc		onv	
	Logistics and Mobility: Specialisation En Mechanical Engineering: Core qualificat		u y	
	Mechatronics: Core qualification: Comp			

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

Course L0612: Product	ion 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: Product	ion Engineering II
Тур	Lecture
Hrs/wk	
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	 Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology
Literature	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

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Mechanical Eng Advanced Mech taking part succe passing the mod express the pro- complex design describe workin explain guidelin explain guidelin explain advance passing the mod analyze comple convert principl use methods to create a techni functions of the document calcu	anical Engineering essfully, students his lule, students are all ocedure for systema in tasks , ing principles, their u nes for designing for ed use-oriented know lule, students are all ex tasks and develop le solutions into a d o design and solve e ical documentation e system, ulations of selected	ave reached the following le ble to: atically handling of use and combination possib in function and manufacturin owledge of machine element ble to: p principle solutions using s letailed design, engineering design tasks sys- including all necessary tea machine elements clearly a	ilities, ng, nts. sketches, stematically and so chnical drawings to	
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passing the mod express the pro complex design describe workin explain guidelin explain advance passing the mod analyze comple convert principl use methods to create a techni functions of the document calcu	lule, students are all ocedure for systema in tasks, ing principles, their u nes for designing for ed use-oriented know lule, students are all ex tasks and develop le solutions into a d o design and solve e ical documentation e system, ulations of selected	ble to: atically handling of use and combination possib r function and manufacturir owledge of machine elemer ble to: p principle solutions using s letailed design, engineering design tasks sys including all necessary teo machine elements clearly a	ilities, ng, nts. sketches, stematically and so chnical drawings to	
express the pro complex design describe workin explain guidelin explain advance passing the mod analyze comple convert principl use methods to create a techni functions of the document calcu	becedure for systema in tasks , ing principles, their un ness for designing for ed use-oriented know lule, students are all ex tasks and develop le solutions into a d or design and solve efficient documentation e system, ulations of selected	atically handling of use and combination possib r function and manufacturir owledge of machine elemen ble to: p principle solutions using s letailed design, engineering design tasks sys including all necessary teo machine elements clearly a	ng, nts. sketches, stematically and so chnical drawings to	
express the pro complex design describe workin explain guidelin explain advance passing the mod analyze comple convert principl use methods to create a techni functions of the document calcu	becedure for systema in tasks , ing principles, their un ness for designing for ed use-oriented know lule, students are all ex tasks and develop le solutions into a d or design and solve efficient documentation e system, ulations of selected	atically handling of use and combination possib r function and manufacturir owledge of machine elemen ble to: p principle solutions using s letailed design, engineering design tasks sys including all necessary teo machine elements clearly a	ng, nts. sketches, stematically and so chnical drawings to	
analyze complet convert principl use methods to create a techni functions of the document calcu passing the mod	ex tasks and develop le solutions into a d o design and solve e ical documentation e system, ulations of selected	p principle solutions using s letailed design, engineering design tasks sys including all necessary teo machine elements clearly a	stematically and so chnical drawings to	
	lule, students are al			
	iule, students are ai	hla ta:		
	cuss solutions and	technical drawings within g groups of the course	iroups,	
passing the mod	lule, students are al	ble to:		
knowledge and	solve complex designed selecting appropria ly solve problems.	gn projects, while motivatir ate methods,	ng themselves, acq	uiring necessa
pendent Study Tir	me 124, Study Time	e in Lecture 56		
pulsor Bonus None	Form Attestation	Description		
en exam				
s Aircraft System: eral Engineering : s Product Develop eral Engineering : s Theoretical Mec eral Engineering s Aircraft System: eral Engineering	s Engineering: Com Science (German p pment and Producti Science (German p chanical Engineering Science (English p s Engineering: Com Science (English p pment and Producti	npulsory program, 7 semester): Spe- ion: Compulsory program, 7 semester): Spe- g: Elective Compulsory program, 7 semester): Spe- npulsory program, 7 semester): Spe-	cialisation Mechani cialisation Mechani cialisation Mechani	cal Engineerin cal Engineerin cal Engineerin
	pulsor B onus None en exam eral Engineering s Aircraft System eral Engineering s Product Develo rral Engineering s Aircraft System ral Engineering s Aircraft System eral Engineering s Product Develo	pulsor B onus Form None Attestation en exam ral Engineering Science (German p s Aircraft Systems Engineering: Com ral Engineering Science (German p s Product Development and Product ral Engineering Science (German p s Theoretical Mechanical Engineering ral Engineering Science (English p s Aircraft Systems Engineering: Com ral Engineering Science (English p	None Attestation en exam eral Engineering Science (German program, 7 semester): Spe s Aircraft Systems Engineering: Compulsory eral Engineering Science (German program, 7 semester): Spe s Product Development and Production: Compulsory eral Engineering Science (German program, 7 semester): Spe s Theoretical Mechanical Engineering: Elective Compulsory eral Engineering Science (English program, 7 semester): Spe s Aircraft Systems Engineering: Compulsory	pulsorBonus Form Description None Attestation enexam

purse L0266: Advanced Mechanical Design Project		
Typ Project-/problem-based Learning		
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen	
Language	DE	
Cycle	WiSe	
Content	 Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung. Getriebekonstruktion in Einzelarbeit Erarbeitung von Lösungsprinzipien Berechnung von Maschinenelementen Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten Erstellung einer ausführlichen Dokumentation Lösungsfindung Methodische Erarbeitung von prinzipiellen Lösungskonzepten Erstellen einer Dokumentation 	
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen 	

Courses				
Title Introduction to Control System Introduction to Control System		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 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 r	eached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in term of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain an implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain a vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequen response techniques They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks 			
Personal Competence				
Social Competence	Students can work in small groups to jointly se	olve technical problems, and e	xperimental	ly validate the
	controller designs Students can obtain information from prov experiment guides) and use it when solving gi	vided sources (lecture notes		
Autonomy	They can assess their knowledge in weekly on	-line tests and thereby control	their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German program Bioprocess Engineering: Core qualification: Co Computer Science: Specialisation Computation Data Science: Core qualification: Elective Corr Electrical Engineering: Core qualification: Corr Energy and Environmental Engineering: Core General Engineering Science (English progr Compulsory General Engineering Science (English progr Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra	mpulsory nal Mathematics: Elective Com pulsory pulsory qualification: Compulsory am, 7 semester): Specialisat gram, 7 semester): Specialisation	pulsory tion Electric lisation Civ on Bioproces	al Engineerin il Engineerin 55 Engineerin

	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
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Eollowing Curricula	Focus Aircraft Systems Engineering: Compulsory
ronowing curricula	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	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 plots Root locus design of PID controllers
Content	 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 Disits located
	 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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 M0726: P	roduction Technology			
Courses				
Title Fundamentals of Machine Tools (L0689) Fundamentals of Machine Tools (L1992) Forming and Cutting Technology (L0613) Forming and Cutting Technology (L0614)		Typ Lecture Recitation Section (large) Lecture Recitation Section (large)	Hrs/wk 2 1 2 1	CP 2 1 2 1
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge		-		
Educational Objectives	After taking part successfully, students have read	ched the following learning	results	
Professional Competence				
Knowledge	 explain the basics of chip formation and mechanisms and models of machining. explain methods and parameters for design and analysis of metal forming, machining processes and tools. explain technical concepts of machine tool building and give an overview on trends in the machine tool industry. explain types, constructions and functions of CNC-machines and give an overview on multimachine systems. explain equipment components. 			
Skills	 Students are able to select tool geometry, cutting materials, process parameters and appropriate measuring technique in accordance with the requirements. estimate occurring forces and temperatures during chip formation. select appropriate machine tools for machining and create NC programs for turning and milling. assess the quality of a machine tools and to detect weak points. 			
Personal Competence				
Social Competence	 Students are able to develop solutions in a production environment with qualified personnel at technical level a represent decisions. 		hnical level and	
Autonomy	 Students are able to interpret independently cutting processes. create independently NC programs. select independently machine tools by reference to appropriate requirements. assess own strengths and weaknesses in general. assess their learning progress and define gaps to be improved. assess possible consequences of their actions. 			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points				
Course achievement				
Examination Examination duration and scale				
Assignment for the	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 Product Development and Production: Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory			

Course L0689: Fundam	entals of Machine Tools
	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Thorsten Schüppstuhl
Language	
Cycle	wise Terminology and trends in machine tool building
	CNC controls
	NC programming and NC programming systems
Content	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
Literature	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
	ISBN: 9783540225041
	Berlin [u.a.]: Springer, 2005
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen
	ISBN: 3540225072
	Berlin [u.a.]: Springer, 2006
	Weck, Manfred; Brecher, Christian
	Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006

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

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

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

Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L032	21)		Lecture	3	4
Computer Engineering (L032	24)		Recitation Section (small) 1	2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	NODA				
•	Basic knowledge in ele	ectrical engineering			
Previous Knowledge					
· · ·		essfully, students hav	ve reached the following learnin	g results	
Professional Competence					
Knowledge	from the assembly-lev Introduction Combinational combinational r Sequential logic Technological fo Computer arithm	el programming dow logic: Gates, Boo networks :: Flip-flops, automat pundations metic: Integer additio	the functionality of computing n to gates. The module includes plean algebra, Boolean func a, systematic hardware design on, subtraction, multiplication an	s the following tions, hardw nd division	topics: are synthesi
	 Memories: Mem Input/output: I/ connections, bu The students perceiv internal structure and highly specific and in components. They are 	ory hierarchies, SRA O from the perspectors sses e computer system the physical compo ndividual computers a able to distinguish	gramming models, MIPS single- M, DRAM, caches tive of the CPU, principles of s from the architect's perspe sition of computer systems. The can be built based on a c between and to explain the c nd circuits up to complete proce	passing data ctive, i.e., th e students ca ollection of fu ifferent abstra	, point-to-poi ey identify t n analyze, ho ew and simp
Skills	After successful completion of the module, the students are able to judge the interdependenci between a physical computer system and the software executed on it. In particular, they shounderstand 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 se	olve similar problems	s alone or in a group and to pres	sent the result	s accordingly
			dge from specific literature and		
Workload in Hours	Independent Study Tir	ne 124, Study Time i	n Lecture 56		
Credit points	6				
Course achievement	Compulsor B onus	Form	Description		
Examination	Yes 10 %	Excercises			
Examination duration					
and scale	90 minutes, contents o	of course and labs			
	Compulsory General Engineering S Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulsor	Science (German pro Science (German Science (German pro Science (German pro Science (German pro Science (German pro	program, 7 semester): Speci ogram, 7 semester): Specialisa program, 7 semester): Special rogram, 7 semester): Specialisa ogram, 7 semester): Specialisat orogram, 7 semester): Specialisat	tion Bioproce alisation Nava sation Electric tion Biomedic ion Energy an	ss Engineerin al Architectur al Engineerin al Engineerin d Enviroment
	Compulsory General Engineering S Focus Mechatronics: C	Science (German pro ompulsory Science (German pro	ogram, 7 semester): Specialisa ogram, 7 semester): Specialisa	tion Mechanic	al Engineerin

	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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
	Computer Science: Core gualification: Compulsory
Assignment for the	Data Science: Core qualification: Elective Compulsory
Following Curricula	Electrical Engineering: Core qualification: Compulsory
-	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: 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	 Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output 	
Literature	 A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. 	

Course L0324: Compute	urse 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		

tegrated Produ	uct Development	and Lightweight D	esign	
		Τνρ	Hrs/wk	СР
		Project-/problem-based	2	2
Design Products (L0270)	Learning Lecture	2	2
nent I (L0269)		Lecture	2	2
Prof. Dieter Krause				
None				
Advanced Knowledge	about engineering desig	n:		
Fundamentals of Mech	nanical Engineering Desi	an		
	5 5	5		
Advanced Mechanical	Engineering Design			
After taking part succe	essfully, students have re	eached the following learning	results	
After completing the n	nodule, students are cap	able of:		
 explaining the f 	unctional principle of 3D	-CAD-Systems. PDM- and FEN	1-Svstems	
				ent process
After completing the r	nodule, students are abl	e to:		
and completing the h	noulle, students are us			
 evaluate different CAD- and PDM-Systems with regards to the desired requirements such a classification schemes and product structuring 				
 design an exemplary product using CAD-,PDM- and/or FEM-Systems with shared workload 				
After completing the n	nodule, students are abl	e to:		
• To develop a project plan and allocate work appropriate work packages in the framework of				
group discussions				
Present project results as a team for instance in a presentation				
Students are capable of	of:			
 independently a 	adapt to a CAE-Tool and	complete a given practical ta	sk with it	
Independent Study Tir	me 96 Study Time in Leo	ture 84		
· · ·	ne 50, study nine in Ee			
Compulsor₿onus	Form	Description		
Yes 20 %	Subject theoretical	and CAE-Teamprojekt inkl.	Vortrag und	Ausarbeitung
Writton oxom	ргастісаї могк			
90				
			on Mechanio	cal Engineering
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,				
Focus Product Development and Production: Compulsory				
Engineering Science: Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering.				
Focus Aircraft Systems Engineering: Compulsory				
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory				
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:				
Elective Compulsory Mechanical Engineering: Specialisation Product Development and Production: Compulsory				
	ng: Specialisation Produc	t Development and Productio	n: Compulso	iry
Mechanical Engineerin Mechanical Engineerin	ng: Specialisation Aircraft	t Development and Productio t Systems Engineering: Comp ction: Technical Complemen	ulsory .	
	Design Products (L0270 nent I (L0269) Prof. Dieter Krause None Advanced Knowledge Fundamentals of Mech Mechanical Engineerin Advanced Mechanical After taking part succe After completing the r • explaining the f • describing the r • describing the r • describing the r • evaluate different classification sc • design an exem After completing the r • evaluate different classification sc • design an exem After completing the r • To develop a p group discussio • Present project Students are capable • independently a Independent Study Tim 6 Compulsor g onus Yes 20 % Written exam 90 General Engineering Focus Aircraft System General Engineering Focus Product Develop	Design Products (L0270) tent I (L0269) Prof. Dieter Krause None Advanced Knowledge about engineering desig Fundamentals of Mechanical Engineering Design Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design After taking part successfully, students have re After completing the module, students are cap • explaining the functional principle of 3D • describing the interaction of the differer After completing the module, students are able • evaluate different CAD- and PDM-Syst classification schemes and product stru • design an exemplary product using CAE After completing the module, students are able • evaluate different CAD- and PDM-Syst classification schemes and product stru • design an exemplary product using CAE After completing the module, students are able • To develop a project plan and allocate group discussions • Present project results as a team for ins Students are capable of: • independently adapt to a CAE-Tool and Independent Study Time 96, Study Time in Lee 6 CompulsorPonus Form Yes 20 % Subject theoretical practical work Written exam 90 General Engineering Science (German progre Focus Aircraft Systems Engineering: Compulso General Engineering Science (English progra Focus Aircraft Systems Engineering: Compulso General Enginee	Typ Project/problem-based Learning Design Products (L0270) Lecture texture Lecture Lecture Lecture None Lecture Advanced Knowledge about engineering Design Mechanical Engineering Design Mechanical Engineering Design Mechanical Engineering Design Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design After taking part successfully, students have reached the following learning Learning After completing the module, students are capable of: • explaining the functional principle of 3D-CAD-Systems, PDM- and FEM • describing the interaction of the different CAE-Systems in the product After completing the module, students are able to: • evaluate different CAD- and PDM-Systems with regards to the de classification schemes and product structuring • design an exemplary product using CAD-, PDM- and/or FEM-Systems of group discussions • Present project results as a team for instance in a presentation Students are capable of: • independently adapt to a CAE-Tool and complete a given practical ta independent Study Time 96, Study Time in Lecture 84 5 Compulsorgionus Form Description Yes 20 % Subject theoretical and CAE-Teamprojekt inkl.	Project-/problem-based Learning 2 Design Products (L0270) Lecture 2 Prof. Dieter Krause None 2 None Advanced Knowledge about engineering design: 2 Fundamentals of Mechanical Engineering Design Mechanical Engineering: Design Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design Advanced Mechanical Engineering Design After taking part successfully, students have reached the following learning results After completing the module, students are capable of: • explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems After completing the module, students are able to: • design an exemplary product structuring • design an exemplary product using CAD-PDM- and/or FEM-Systems with shared to After completing the module, students are able to: • to develop a project plan and allocate work appropriate work packages in th group discussions • Present project results as a team for instance in a presentation Students are capable of: • independently adapt to a CAE-Tool and complete a given practical task with it Independent Study Time 96, Study Time in Lecture 84 6 6 Compulsor§fonus Form Description Yes 20 % Subject theoretical

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

Course L0270: 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	 Lightweight design materials Product development process for lightweight structures Dimensioning of lightweight structures
Literature	 Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986.

urse L0269: Integrat	ed 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	 Introduction to Integrated Product Development 3D CAD -Systems and CAD interfaces Administration of part lists / PDM systems PDM in different industries Selection of CAD-/PDM Systems Simulation Construction methods Design for X
Literature	 Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag

Courses				
litle		True	Line (mile	СР
	eramics and Polymers (L1233)	Typ Lecture	Hrs/wk 2	2 2
	eramics and Polymers (L1234)	Recitation Section (large	-	1
Enhanced Fundamentals: M	etals (L1086)	Lecture	2	3
	Prof. Gerold Schneider			
Admission Requirements	None			
	Module "Fundamentals of Materials S	cience"		
Recommended Previous Knowledge	Module "Materials Science Laboratory	zu		
	Module "Advanced Materials"			
ducational Objectives	After taking part successfully, studen	ts have reached the following learnin	g results	
Professional Competence				
Knowledge	The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects , electr and mass transport, microstructure and phase diagrams. They are capable to explain the correspond technical terms.			
Skills	The students are able to apply th mentioned subjects.	ne appropriate physical and chemi	cal methods	for the abo
Personal Competence				
Social Competence				
Autonomy	The students are capable to understand independently the structure and propeties of ceramics, met and polymers. They should be able to critally evaluate the profoundness of their knowledge.			
Workload in Hours	Independent Study Time 110, Study	Fime in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	1180 mm			
Assignment for the Following Curricula				

Course L1233: Enhance	ed Fundamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner
Language	DE/EN
Cycle	SoSe
	1. Einführung Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik

	2. Pulverherstellung
	Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition
	Pulveraufbereitung
	Mahltechnik Sprühtrockner
	3. Formgebung
	Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte)
Content	4. Sintern
	Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften Anwendungen
	Keramische Ionenleiter
	lonische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
	D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications and Design, Elesevier
	D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992
	W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975
	D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press, 1998
	D. Munz, T. Fett, Ceramics, Springer, 2001
Literature	
	Polymerwerkstoffe Struktur und mechanische Eigenschaften G.W.Ehrenstein; Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	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: Enhance	ourse L1234: Enhanced Fundamentals: Ceramics and Polymers		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

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

Courses				
Fitle Management Tutorial (L088 ntroduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Busine	55		
ducational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	 After taking this module, students know the important basics of many different areas in Business an Management, from Planning and Organisation to Marketing and Innovation, and also to Investment an Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines i Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, suppl chain management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematica Finance state basics from accounting and costing and selected controlling methods. 			
Skills	 strategies etc.) and to carry out an Entrepret analyse Management goals and struct analyse organisational and staff struct apply methods for decision making ur analyse production and procurement analyse and apply basic methods of m select and apply basic methods from 	staff structures of companies making under multiple objectives, under uncertainty and under risk curement systems and Business information systems		
Personal Competence				
· · · · · · · · · · · · · · · · · · ·	Students are able to			
Social Competence	 work successfully in a team of student to apply their knowledge from the le report on the project to communicate appropriately and to cooperate respectfully with their fe 	cture to an entrepreneurship p	roject and w	rite a coheren
	Students are able to			
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				
Course achievement				
Examination	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German progra Civil- and Environmental Engineering: Core of Civil- and Environmental Engineering: Specia Civil- and Environmental Engineering: Specia Civil- and Environmental Engineering: Specia Bioprocess Engineering: Core qualification: Core Outer Science: Core qualification: Computer Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Core Energy and Environmental Engineering: Core	ualification: Compulsory lisation Civil Engineering: Electi lisation Water and Environment lisation Traffic and Mobility: Ele ompulsory Ilsory mpulsory	ve Compulso : Elective Co	ory ompulsory

1	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	
y	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
1	Process Engineering: Core qualification: Compulsory

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

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

Focus Theoretical Mechanical Engineering

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

Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering Design II (L0264) Advanced Mechanical Engineering Design II (L0265)		Lecture	2 2	2 1
Advanced Mechanical Engin		Recitation Section (large) Lecture	2	2
Advanced Mechanical Engin		Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous Knowledge	 Fundamentals of Mechanical Eng Mechanics Fundamentals of Materials Science Production Engineering 			
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
	After passing the module, students are	able to:		
Knowledge	 explain complex working principles and functions of machine elements and of basic elements fluidics, explain requirements, selection criteria, application scenarios and practical examples of complemachine elements, indicate the background of dimensioning calculations. 			
Skills	 After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solvir skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. 			
Personal Competence				
Social Competence	 Students are able to discuss technical information in the lecture supported by activatir methods. 			d by activatin
Autonomy	 Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood conter e.g. by using the video recordings of the lectures. 			
	Independent Study Time 68, Study Time	e in Lecture 112		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	120			
	General Engineering Science (German Focus Aircraft Systems Engineering: Col General Engineering Science (German Focus Materials in Engineering Sciences General Engineering Science (German Focus Mechatronics: Compulsory General Engineering Science (German Focus Product Development and Produc General Engineering Science (German Focus Theoretical Mechanical Engineerin General Engineering Science (German	npulsory program, 7 semester): Specialisati : Compulsory program, 7 semester): Specialisati program, 7 semester): Specialisati tion: Compulsory program, 7 semester): Specialisati ng: Compulsory	on Mechani on Mechani on Mechani on Mechani	cal Engineering cal Engineering cal Engineering cal Engineering

	Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
Following Curricula	Energy Systems: Technical Complementary Course Core Studies: Elective 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

ourse L0264: Advanced Mechanical Engineering Design II			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff		
Language	DE		
Cycle			
-	Advanced Mechanical Engineering Design I & II		
	Ecture Fundamentals of the following machine elements:		
	 Linear rolling bearings Axes & shafts Seals Clutches & brakes Belt & chain drives 		
Content	 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 Epicyclic gears Crank gears Sliding bearings Calculations of hydrostatic systems (fluidics) 		
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlaktuelle 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, Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer View aktuelle Auflage. 		
	aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen		

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

	ed Mechanical Engineering Design I
Тур	Lecture
Hrs/wk	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 • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Sliding bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Sliding bearings • Clutches & brakes • Belt & chain drives • Sliding bearings • Crank gears • Sliding bearings • Calculations of hydrostatic systems (fluidics)
Literature	 Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verla aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuell Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Viewe aktuelle Auflage.

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

Courses				
Title Signals and Systems (L0432	2)	Typ Lecture	Hrs/wk	CP 4
Signals and Systems (L043)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
	Mathematics 1-3			
	The modul is an introduction to the theory of sig by the moduls Mathematik 1-3 is expected. Fu series, Fourier transform, Laplace transform) is	irther experience with spectr		
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional				
Competence Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems usi 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 determine			
Skills	The students are able to describe and analyse using methods of signal and system theory. T important properties such as magnitude and p the impact of LTI systems on the signal properti	They can analyse and design hase response, stability, line	n basic sys arity etc 1	tems regardi
Personal Competence				
Social Competence	The students can jointly solve specific problems			
Autonomy	The students are able to acquire relevant info control their level of knowledge during the lect clicker system.			
Workload in Hours	Independent Study Time 110, Study Time in Lea	cture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
	General Engineering Science (German progra	im, 7 semester): Specialisat	ion Electric	al Engineerii
	Compulsory General Engineering Science (German prog	ram, 7 semester): Speciali	sation Com	nputer Scien
	Compulsory	· · · ·		
	General Engineering Science (German progra Compulsory	am, 7 semester): Specialisa	ation Proce	ss Engineerii
	General Engineering Science (German program	m, 7 semester): Specialisatio	on Bioproce	ss Engineerir
	Compulsory		D'	
	General Engineering Science (German prograr Compulsory	m, / semester): Specialisatio	on Biomedia	cal Engineerii
	General Engineering Science (German program	m, 7 semester): Specialisatio	on Mechanio	al Engineerir
	Focus Biomechanics: Compulsory General Engineering Science (German prograr	n 7 semester): Specialisatio	n Mechanic	al Engineerir
	Focus Energy Systems: Compulsory	n, 7 semester). Specialisatio		ai Liigineeni
	General Engineering Science (German program		on Mechanio	al Engineerir
	Focus Aircraft Systems Engineering: Compulsor General Engineering Science (German program		on Mechanio	al Engineerir
	Focus Materials in Engineering Sciences: Compu General Engineering Science (German program	ulsory		5
	Focus Mechatronics: Compulsory			5
	General Engineering Science (German prograr Focus Theoretical Mechanical Engineering: Com	pulsory	on Mechanic	tai Engineerir
Assignment for the	Computer Science: Core qualification: Compulse Electrical Engineering: Core qualification: Comp	oulsory		
Following Curricula	General Engineering Science (English progra	m, 7 semester): Specialisat	ion Electric	al Engineerii
	Compulsory General Engineering Science (English progr	am 7 semester). Speciali	sation Com	nuter Scien
	Compulsory			
	General Engineering Science (English progra	am, 7 semester): Specialisa	ation Proce	ss Engineerii
	Compulsory General Engineering Science (English progran	n, 7 semester): Specialisatio	on Bioproce	ss Engineerir
	Compulsory General Engineering Science (English progran	n 7 competerly Englisher	n Diamadi	al Engineeri

C	ompulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Biomechanics: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Energy Systems: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Aircraft Systems Engineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Materials in Engineering Sciences: Compulsory
	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
	omputational Science and Engineering: Core qualification: Compulsory
	lechatronics: Core qualification: Compulsory
Te	echnomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

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

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

Module M0684: H	eat Transfer				
Courses					
Title	Ту	-	Hrs/wk	СР	
Heat Transfer (L0458) Heat Transfer (L0459)		cture citation Section (large)	3 2	4 2	
		station Section (large)	2	2	
Admission	Dr. Andreas Moschallski				
Requirements	None				
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics				
Educational Objectives	After taking part successfully, students have reached t	the following learning r	esults		
Professional Competence					
	The students are able to				
	- describe the different physical mechanism of Heat Tr	ansfer,			
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					
	- 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 a critic way. A qualified exchange with other students is given.				
Workload in Hours		0			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	General Engineering Science (German program, 7 se Focus Energy Systems: Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Focus Theoretical Mechanical Engineering: Elective Co General Engineering Science (German program, 7 se Focus Theoretical Mechanical Engineering: Compulsory Energy Systems: Technical Complementary Course Co General Engineering Science (English program, 7 se Focus Theoretical Mechanical Engineering: Elective Co General Engineering Science (English program, 7 se Focus Theoretical Mechanical Engineering: Elective Co General Engineering Science (English program, 7 se Focus Energy Systems: Compulsory	emester): Specialisatio emester): Specialisatio mpulsory emester): Specialisation y re Studies: Elective Con emester): Specialisation mpulsory	n Biomedic n Mechanic n Mechanic mpulsory n Mechanic	al Engineering al Engineering al Engineering al Engineering	

ourse L0458: Heat Transfer		
Тур	Lecture	
Hrs/wk	3	
CP	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 (steady and unsteady), Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux	
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996 	

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

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Module M1320: S	imulation and Design of Mechatro	nic Systems		
Courses				
Title Simulation and Design of Me Simulation and Design of Me Simulation and Design of Me	echatronic Systems (L1823)	Typ Lecture Recitation Section (large) Practical Course	Hrs/wk 2 1 1	CP 2 2 2
Module Responsible	Prof Llwe Weltin			
Admission Requirements				
Recommended Previous Knowledge	Fundatmentals of mechanics, control theory and e	lectrical engineering		
Educational Objectives	After taking part successfully, students have reach	ned the following learning	results	
Professional Competence	Students are able to describe methods and	calculations for design.	modelina.	simulation and
	optimization of mechatronic systems. Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify,			
Personal Competence	simulate and design simple systems and impleme	nt those in laboratory conc	altions.	
Social Competence	Students are able to work goal oriented in small mixed groups and present results to target groups			
Autonomy	Students are able to recognize and improve knowledge deficits independently. With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	90 min			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory Digital Mechanical Engineering: Core qualification: 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 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: Elective Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Compulsory			

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

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

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

Courses Title Production Engineering I (LC Production Engineering I (LC Production Engineering II (L	0612) 0610)	Typ Lecture Recitation Section (large) Lecture	Hrs/wk 2 1 2	CP 2 1 2
Production Engineering II (L	0611)	Recitation Section (large)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	no course assessments required internship recommended			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence	Students are able to • name basic criteria for the selection of mar • name the main groups of Manufacturing Te			
Knowledge	 name the application areas of different manufacturing processes. name boundaries, advantages and disadvantages of the different manufacturing process. 			
Skills	 Students are able to select manufacturing processes in accordance with the requirements. design manufacturing processes for simple tasks to meet the required tolerances of th component to be produced. assess components in terms of their production-oriented construction. 			
Personal Competence				
Social Competence	 Students are able to develop solutions in a production environ represent decisions. 	ment with qualified perso	nnel at tecł	nical level a
Autonomy	 Students are able to interpret independently the manufacturing assess own strengths and weaknesses in g assess their learning progress and define e assess possible consequences of their action 	eneral. gaps to be improved.		
Workload in Hours	Independent Study Time 96, Study Time in Lectur	re 84		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German program, Focus Product Development and Production: Com General Engineering Science (German program, Focus Theoretical Mechanical Engineering: Electiv Digital Mechanical Engineering: Core qualification Engineering Science: Specialisation Mechanical El General Engineering Science (English program, Compulsory General Engineering Science (English program, Focus Product Development and Production: Com General Engineering Science (English program, Focus Theoretical Mechanical Engineering: Electiv	 pulsory 7 semester): Specialisation 7 semester): Specialisation 7 compulsory 7 semester): Specialisation 	on Mechanic on Mechanic on Mechanic	cal Engineerin cal Engineerin cal Engineerin

Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

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

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

Course L0610: Producti	on Engineering II
Тур	Lecture
Hrs/wk	
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	 Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology
Literature	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

urse L0611: Production Engineering II	
-	

Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (LC	9417)	Lecture	2	3
Numerical Mathematics I (LC	0418)	Recitation Section (small)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	 Mathematik I + II for Engineering Stud for Technomathematicians basic MATLAB knowledge 	lents (german or english) or Ana	alysis & Line	ar Algebra I +
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional				
Competence				
	Students are able to			
Knowledge	 name numerical methods for interp problems, nonlinear root finding probl repeat convergence statements for th explain aspects for the practical exec and storage complexitx. 	ems and to explain their core id e numerical methods,	eas,	
	Students are able to			
Skills	 implement, apply and compare numeric justify the convergence behaviour convergence behaviour convergence and execute a suitable solution 	of numerical methods with re-	spect to th	e problem an
Personal Competence				
-	Students are able to			
Social Competence	 work together in heterogeneously co and background knowledge), explai practical aspects regarding the impler 	n theoretical foundations and		
	Students are capable			
Autonomy	 to assess whether the supporting individually or in a team, to assess their individual progess and, 			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement	None			
Examination				
Examination duration	90 minutes			
and scale	General Engineering Science (German pr			
	Compulsory General Engineering Science (German prog Focus Materials in Engineering Sciences: Cor General Engineering Science (German prog Compulsory General Engineering Science (German prog Focus Biomechanics: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: C Bioprocess Engineering: Specialisation A - Ge Computer Science: Specialisation Computati Computer Science: Specialisation II. Mathem Data Science: Core qualification: Ele Engineering Science (Core qualification: Com General Engineering Science (English prog	npulsory ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ompulsory eneral Bioprocess Engineering: E onal Mathematics: Elective Com atics and Engineering Science: E ctive Compulsory pulsory	on Biomedic on Mechanic Don Mechanic Elective Com pulsory Elective Com	al Engineering al Engineering al Engineering pulsory pulsory
Assignment for the Following Curricula	Focus Theoretical Mechanical Engineering: E General Engineering Science (English progra General Engineering Science (English progra	lective Compulsory m, 7 semester): Core qualificati	on: Compuls	ory

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Biomechanics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engine	eering:
Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	
Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: E	lective
Compulsory	
Process Engineering: Specialisation Process Engineering: Elective Compulsory	

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

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

Module M0596: A	dvanced Mecha	anical Design P	roject		
Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Desig	jn Project (L0266)		Project-/problem-based Learning	4	6
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge		ineering: Design nanical Engineering De	sign		
Educational Objectives	After taking part succe	essfully, students have	e reached the following learnin	g results	
Professional Competence		ule, students are able	to		
Knowledge	 After passing the module, students are able to: express the procedure for systematically handling of complex design tasks , describe working principles, their use and combination possibilities, explain guidelines for designing for function and manufacturing, explain advanced use-oriented knowledge of machine elements. After passing the module, students are able to:				
Skills	 analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, 				
Personal Competence					
Social Competence	 present and dis 	 After passing the module, students are able to: present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course 			
Autonomy		solve complex design selecting appropriate	projects, while motivating the	mselves, acqu	uiring necessa
Workload in Hours	Independent Study Tir	ne 124, Study Time ir	Lecture 56		
Credit points	6				
Course achievement	Compulsor Bonus Yes None	Form Attestation	Description		
Examination	Written exam				
Examination duration and scale	180				
Assignment for the Following Curricula	Focus Aircraft System: General Engineering Focus Product Develop General Engineering Focus Theoretical Mec General Engineering Focus Aircraft System: General Engineering Focus Product Develop	s Engineering: Compu Science (German pro- oment and Production Science (German pro- hanical Engineering: I Science (English pro- s Engineering: Compu Science (English pro- oment and Production Science (English pro-	gram, 7 semester): Specialisa : Compulsory gram, 7 semester): Specialisa Elective Compulsory gram, 7 semester): Specialisa Isory gram, 7 semester): Specialisa : Compulsory gram, 7 semester): Specialisa	tion Mechanic tion Mechanic tion Mechanic tion Mechanic	cal Engineerin cal Engineerin cal Engineerin cal Engineerin

ourse L0266: Advance	ed Mechanical Design Project			
Тур	Project-/problem-based Learning			
Hrs/wk				
СР				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Lecturer	Jens Schmidt, Dr. Volkert Wollesen			
Language	DE			
Cycle	WiSe			
Content	 Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung. Getriebekonstruktion in Einzelarbeit Erarbeitung von Lösungsprinzipien Berechnung von Maschinenelementen Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten Erstellung einer ausführlichen Dokumentation Lösungsfindung Methodische Erarbeitung von prinzipiellen Lösungskonzepten Erstellen einer Dokumentation 			
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen 			

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2	CP 4 2
Module Responsible				
Admission Bequirements				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in tin	ne and frequency domain, Laplad	ce transform	
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can i particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in term of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequenc response They can explain issues arising when controllers designed in continuous time domain ar implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain a vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequer response techniques They can calculate discrete-time approximations of controllers designed in continuous-time a use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks 			
Personal Competence	Students can work in small groups to jointly	solve technical problems, and e	vnerimentall	ly validate th
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate th 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 progress.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and scale	120 min			
	General Engineering Science (German progr Bioprocess Engineering: Core qualification: (Computer Science: Specialisation Computati Data Science: Core qualification: Elective Co Electrical Engineering: Core qualification: Co Energy and Environmental Engineering: Corr General Engineering Science (English pro Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Compulsory General Engineering Science (English prog Engineering: Compulsory General Engineering Science (English prog	Compulsory onal Mathematics: Elective Com mpulsory e qualification: Compulsory gram, 7 semester): Specialisat rogram, 7 semester): Specialisatio ram, 7 semester): Specialisatio	pulsory ion Electrica lisation Civ on Bioproces	al Engineerir il Engineerir ss Engineerir

	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,
Assignment for the	Focus Aircraft Systems Engineering: Compulsory
Following Curricula	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 Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
	Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core gualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective
	Compulsory
	Process Engineering: Core qualification: Compulsory

Course 10654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
	 Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
	Signals and systems Linear systems, differential equations and transfer functions
	 First and second order systems, poles and zeros, impulse and step response Stability
	Feedback systems
	 Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control
	 System type and steady-state error, error constants Internal model principle
	 Root locus techniques Root locus plots Root locus design of PID controllers
Content	 Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control
	 Time delay systems Root locus and frequency response of time delay systems Smith predictor
	Digital control
	 Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Software tools
	 Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduc	ourse L0655: Introduction to Control Systems			
Тур	Recitation Section (small)			
Hrs/wk	2			
СР	2			
Workload in Hours	ependent 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
Computer Engineering (L0321)			Lecture	3	4
Computer Engineering (L032	24)		Recitation Section (small) 1	2
Module Responsible					
Admission Requirements	None				
Recommended	Basic knowledge in ele	ectrical engineering			
Previous Knowledge Educational Objectives	After taking part succe	essfully, students ha	ve reached the following learnin	g results	
Professional Competence					
Knowledge Skills	 This module deals with the foundations of the functionality of computing systems. It covers the laye from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesi combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinin: Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses 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, ho highly specific and individual computers can be built based on a collection of few and simp 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	impact that these low feasible options. Students are able to s	w abstraction levels olve similar problem	n to gates. This way, they will have on an entire system's s alone or in a group and to pres dge from specific literature and	performance a	and to propos s accordingly.
Workload in Hours	Independent Study Tir	me 124. Study Time	in Lecture 56		
Credit points	i				
Course achievement		Form	Description		
Examination	Yes 10 % Written exam	Excercises			
Examination duration and scale	90 minutes, contents	of course and labs			
and scale			program, 7 semester): Speci	alisation Com	puter Scienc
	Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory General Engineering General Engineering General Engineering General Engineering Compulsory	Science (German pr Science (German p Science (German pr Science (German pr Science (German pr ory Science (German p	ogram, 7 semester): Specialisa program, 7 semester): Specialisa ogram, 7 semester): Specialisa ogram, 7 semester): Specialisa ogram, 7 semester): Specialisat program, 7 semester): Specialisa	alisation Bioproce alisation Nava sation Electric ation Biomedic ion Energy an isation Proces	ss Engineerin Al Architectur Al Engineerin Al Engineerin d Enviroment Ss Engineerin
	Focus Mechatronics: C	Compulsory Science (German pr	ogram, 7 semester): Specialisa		

	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
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	Focus Energy Systems: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering:
	Compulsory
Assignment for the	Computer Science: Core qualification: Compulsory
Following Curricula	Data Science: Core qualification: Elective Compulsory
ronowing curricula	Electrical Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation II. Informatics: Elective Compulsory
	rechnomathematics: 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	 Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output
Literature	 A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005.

Course L0324: Compute	urse 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		

E.

Module M1573: M	lodeling, Simulation and	l Optimization (GES)		
Courses				
Title Modeling, Simulation and O	ptimization (L2446)	Typ Integrated Lecture	Hrs/wk 4	CP 6
	Prof. Benedikt Kriegesmann			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, stude	ents have reached the following learni	ng results	
Professional Competence				
Knowledge Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study	y Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	30 min			
	Focus Theoretical Mechanical Engin General Engineering Science (Gerr Focus Theoretical Mechanical Engin Engineering Science: Core qualifica General Engineering Science (Englis General Engineering Science (Eng Focus Theoretical Mechanical Engin Mechanical Engineering: Specialisat	man program, 7 semester): Specialis neering: Compulsory ition: Compulsory sh program, 7 semester): Core qualific ilish program, 7 semester): Specialis	ation Mechanic cation: Compute ation Mechanic ng: Elective Con	cal Engineerin sory cal Engineerin mpulsory

Course L2446: Modeling, Simulation and Optimization		
Тур	Integrated Lecture	
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Benedikt Kriegesmann, Prof. Thomas Rung, Prof. Alexander Düster, Prof. Robert Seifried	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Courses				
Title Management Tutorial (L088 Introduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence	After taking this module, students know the im	portant basics of many diffe	erent areas i	in Business ar
Knowledge	 Management, from Planning and Organisation to Controlling. In particular they are able to explain the differences between Econ Management and to name important define explain the most important aspects of ar aspects of entreprneurial projects describe and explain basic business func chain management, organization and hur innovation management and marketing explain the relevance of planning and or multiple objectives and uncertainty, ar Finance state basics from accounting and costing 	omics and Management a hitions from the field of Man ad goals in Management an tions as production, procure nan ressource management decision making in Busines and selected controlling me	and the su agement d name the ement and s c, information as, esp. in s ethods from thods.	b-disciplines most importa ourcing, supp n managemen ituations und mathematic
Skills	Students are able to analyse business units wit strategies etc.) and to carry out an Entrepreneur analyse Management goals and structure analyse organisational and staff structure apply methods for decision making under analyse production and procurement syst analyse and apply basic methods of mark select and apply basic methods from mat apply basic methods from accounting, cos	ship project in a team. In pa them appropriately s of companies multiple objectives, under u ems and Business informati eting nematical finance to predefi	articular, the uncertainty a on systems ned problem	y are able to and under risk
Personal Competence				
Social Competence	 Students are able to work successfully in a team of students to apply their knowledge from the lectur report on the project to communicate appropriately and to cooperate respectfully with their fellow 		roject and w	vrite a cohere
Autonomy	 Students are able to work in a team and to organize the team to write a report on their project. 	themselves		
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, Civil- and Environmental Engineering: Core quali Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Com Computer Science: Core qualification: Compulso Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compu Energy and Environmental Engineering: Core qu	fication: Compulsory tion Civil Engineering: Electi tion Water and Environmeni tion Traffic and Mobility: Ele pulsory ry Ilsory	ve Compuls : Elective Co	ory ompulsory

1	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	Focus Energy Systems: Compulsory
5	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
· · · · · · · · · · · · · · · · · · ·	Process Engineering: Core qualification: Compulsory

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

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

	lathematics IV			
Courses				
Title Differential Equations 2 (Par Differential Equations 2 (Par	tial Differential Equations) (L1043) tial Differential Equations) (L1044) tial Differential Equations) (L1045)	Typ Lecture Recitation Section (small) Recitation Section (large) Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1 1 2 1 1	CP 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 have	e reached the following learning	results	
Professional Competence	 Students can name the basic concept appropriate examples. Students can discuss logical connections. 	-		
Knowledge	 Students can discuss logical connections with the illustrating these connections with the They know proof strategies and can r 	e help of examples.	ts. They	are capable
Skills	 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. Students are able to discover and verify further logical connections between the concept studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able critically evaluate the results. 			
Personal Competence Social Competence	 Students are able to work together in language. In doing so, they can communicate partners. Moreover, they can design peers. 	new concepts according to the	needs of th	eir cooperat
Autonomy	 Students are capable of checking th can specify open questions precisely Students have developed sufficient p oriented manner on hard problems. 	and know where to get help in so	olving them.	
Workload in Hours	Independent Study Time 68, Study Time in I	ecture 112		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and scale	60 min (Complex Functions) + 60 min (Diffe	rential Equations 2)		
	General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Mechatronics: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Focus Theoretical Mechanical Engineering: E Computer Science: Specialisation Computat Computer Science: Specialisation II. Mathen Electrical Engineering: Core qualification: Co Engineering Science: Specialisation Electricat	gram, 7 semester): Specialisatio rogram, 7 semester): Specialis gram, 7 semester): Specialisatio Elective Compulsory ional Mathematics: Elective Com natics and Engineering Science: E ompulsory	on Mechanic sation Nava on Mechanic pulsory	cal Engineerir al Architectu cal Engineerir

	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
Following Curricula	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 II. Mathematics & Engineering Science: Elective
	Compulsory
	Mechanical Engineering: Specialisation Mechatronics: Compulsory
	Mechanical Engineering: Specialisation Mechanical Mechanical Engineering: Elective Compulsory
	5 5 1 5 5 1 7
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: 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	 Main features of the theory and numerical treatment of partial differential equations Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements 	
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 	

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

Course L1045: Differen	rse 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	Course L1038: Complex Functions		
Тур	Lecture		
Hrs/wk	2		
СР	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	Main features of complex analysis Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation 		
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 		

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

Course L1042: Complex	ourse 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	

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

icience I (L1085) icience II (Advanced Ceramic Materials, Polymers and is of Materials Science (L1095) Prof. Jörg Weißmüller None	Typ Lecture Lecture Lecture	Hrs/wk 2 2	CP 2
science II (Advanced Ceramic Materials, Polymers and s of Materials Science (L1095) Prof. Jörg Weißmüller	Lecture Lecture	2	
Prof. Jörg Weißmüller	Lecture		2
		2	2
None			
Highschool-level physics, chemistry und mathemat	tics		
After taking part successfully, students have reach	ed the following learn	ing results	
describe this knowledge comprehensively. Fundan of atomic structure, microstructure, phase diagrar properties. The students know about the key aspec identify relevant approaches for characterizing s	nental knowledge here ns, phase transformat cts of characterization specific properties. The	e means specifi ions, corrosion methods for ma ey are able to	cally the issue and mechanica aterials and ca
of nature. Materials phenomena here refers to m stiffness, chemical properties such as corrosion solidification, precipitation, or melting. The stud	echanical properties s resistance, and to p dents can explain the	such as strengtl hase transform relation betw	n, ductility, ar ations such a een processir
-			
Independent Study Time 96. Study Time in Lecture	84		
Written exam			
180 min			
Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, 7 Engineering: Compulsory Energy and Environmental Engineering: Core quali General Engineering Science (English program, 7 Compulsory	7 semester): Specialis n, 7 semester): Speci 7 semester): Specialisa fication: Compulsory 7 semester): Specialis	sation Biomedic cialisation Nava ation Energy an ation Mechanic	al Engineerin al Architectur d Enviroment al Engineerin
	After taking part successfully, students have reach The students have acquired a fundamental know describe this knowledge comprehensively. Fundan of atomic structure, microstructure, phase diagrar properties. The students know about the key aspe- identify relevant approaches for characterizing s phenomena back to the underlying physical and ch The students are able to trace materials phenome of nature. Materials phenomena here refers to m stiffness, chemical properties such as corrosion solidification, precipitation, or melting. The stu- conditions and the materials microstructure, and the the material's behavior. - - - - - - - - - - - - -	After taking part successfully, students have reached the following learn The students have acquired a fundamental knowledge on metals, ce describe this knowledge comprehensively. Fundamental knowledge her of atomic structure, microstructure, phase diagrams, phase transformat properties. The students know about the key aspects of characterization identify relevant approaches for characterizing specific properties. The students are able to trace materials phenomena back to the underly of nature. Materials phenomena here refers to mechanical properties s stiffness, chemical properties such as corrosion resistance, and to p solidification, precipitation, or melting. The students can explain the conditions and the materials microstructure, and they can account for t the material's behavior. Independent Study Time 96, Study Time in Lecture 84 6 None Written exam 180 min General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialis Compulsory	After taking part successfully, students have reached the following learning results The students have acquired a fundamental knowledge on metals, ceramics and pol describe this knowledge comprehensively. Fundamental knowledge here means specific of atomic structure, nicrostructure, phase diagrams, phase transformations, corrosion a properties. The students know about the key aspects of characterization methods for me identify relevant approaches for characterizing specific properties. They are able to phenomena back to the underlying physical and chemical laws of nature. The students are able to trace materials phenomena back to the underlying physical and of nature. Materials phenomena here refers to mechanical properties such as strength stiffness, chemical properties such as corrosion resistance, and to phase transform solidification, precipitation, or melting. The students can explain the relation betwe conditions and the materials microstructure, and they can account for the impact of mi the material's behavior. - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

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: Fundam	ourse 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	

ourse 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	 Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	 Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer

Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L03			Lecture	3	4
Computer Engineering (L03	-		Recitation Section (sma	ll) 1	2
Module Responsible					
Admission Requirements	None				
	Basic knowledge in el	ectrical engineering			
Previous Knowledge Educational Objectives		essfully students ha	ve reached the following learni	na results	
Professional		costany, statents na	ve reached the following learning		
Competence					
Koowladaa	from the assembly-lev Introduction Combinational combinational	vel programming dov logic: Gates, Bo networks	f the functionality of computing vn to gates. The module include olean algebra, Boolean fun ta, systematic hardware design	es the following octions, hardw	topics:
Knowledge	 Technological f Computer arith Basics of comp Memories: Men 	oundations metic: Integer additi uter architecture: Pr nory hierarchies, SRA /O from the perspe	on, subtraction, multiplication a ogramming models, MIPS single	and division e-cycle architec	
	internal structure and highly specific and i components. They ar today's computing sys	d the physical compo- individual computer re able to distinguisl stems - from gates a	ns from the architect's persp osition of computer systems. T s can be built based on a n between and to explain the nd circuits up to complete proc	he students ca collection of f different abstra essors.	in analyze, ho ew and simp action layers
Skills	After successful completion of the module, the students are able to judge the interdependencie between a physical computer system and the software executed on it. In particular, they sha understand the consequences that the execution of software has on the hardware-centric abstractio layers from the assembly language down to gates. This way, they will be enabled to evaluate th 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 s	solve similar problem	s alone or in a group and to pre	esent the result	s accordingly.
Autonomy	Students are able to with other classes.	acquire new knowle	dge from specific literature an	d to associate	this knowledo
Workload in Hours	Independent Study Ti	me 124, Study Time	in Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus Yes 10 %	Form Excercises	Description		
Examination	Written exam				
Eveningtion duration		of course and labo			
and scale					
	General Engineering Compulsory	Science (German	program, 7 semester): Spec	cialisation Com	iputer Scienc
	General Engineering	Science (German p	rogram, 7 semester): Specialis	ation Bioproce	ss Engineerin
	5 5	Science (German	program, 7 semester): Spec	ialisation Nava	al Architectur
	Compulsory General Engineering	Science (German	program, 7 semester): Spe	cialisation Civ	il Engineerin
	Compulsory		program, 7 semester): Special		5
	Compulsory				-
I	General Engineering	Science (German pi	ogram, 7 semester): Specialis	ation Biomedic	al Engineerin
	Compulsory				
			ogram, 7 semester): Specialisa	ition Energy ar	d Enviroment
	General Engineering Engineering: Compuls General Engineering Compulsory	sory Science (German	ogram, 7 semester): Specialisa program, 7 semester): Specia ogram, 7 semester): Specialis	alisation Proce	ss Engineerin

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

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

Course L0324: Compute	urse 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 Signals and Systems (L043)	Typ 2) Lecture	Hrs/wk 3	CP 4
Signals and Systems (L043)			2
Module Responsible	Prof. Gerhard Bauch		
Admission Requirements	None		
	Mathematics 1-3		
	The modul is an introduction to the theory of signals and systems. by the moduls Mathematik 1-3 is expected. Further experience w series, Fourier transform, Laplace transform) is useful but not requi	ith spectral transform	
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 linea methods of signal and system theory. They are able to apply to continuous-time and discrete-time signals and systems. They can signals and systems mathematically in both time and image doma effects in time domain and image domain which are caused by signal to a discrete-time signal.	the fundamental tra describe and analy in. In particular, they the transition of a	nsformations se determinis v understand t continuous-tir
Skills	The students are able to describe and analyse deterministic signal using methods of signal and system theory. They can analyse a important properties such as magnitude and phase response, sta the impact of LTI systems on the signal properties in time and frequ	nd design basic sys bility, linearity etc	tems regardi
Personal Competence	3		
Social Competence	The students can jointly solve specific problems.		
Autonomy	The students are able to acquire relevant information from appr control their level of knowledge during the lecture period by solvi clicker system.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points			
Course achievement	None		
Examination	Written exam		
Examination duration and scale	I YU MIN		
	General Engineering Science (German program, 7 semester): S Compulsory General Engineering Science (German program, 7 semester): Compulsory		-
	General Engineering Science (German program, 7 semester):	Specialisation Proce	
	Compulsory General Engineering Science (German program, 7 semester): Sp	ecialisation Bioproce	5
	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp		ess Engineerir
	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Focus Biomechanics: Compulsory	ecialisation Biomedi ecialisation Mechani	ess Engineerir cal Engineerir cal Engineerir
	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Energy Systems: Compulsory	ecialisation Biomedi ecialisation Mechani ecialisation Mechani	ess Engineerir cal Engineerir cal Engineerir cal Engineerir
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Assignment for the	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory	ecialisation Biomedi ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani	ess Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir cal Engineerir
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Sp	ecialisation Biomedi ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani	ess Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): S Compulsory General Engineering Science (English program, 7 semester): S Compulsory General Engineering Science (English program, 7 semester): S	ecialisation Biomedi ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani pecialisation Electric Specialisation Con	ess Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Compulsory General Engineering Science (German program, 7 semester): Sp Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Sp Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): S Compulsory General Engineering Science (English program, 7 semester): S Compulsory	ecialisation Biomedi ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani ecialisation Mechani pecialisation Mechani Specialisation Con Specialisation Proce	ess Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin cal Engineerin

Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Biomechanics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Energy Systems: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Aircraft Systems Engineering: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Materials in Engineering Sciences: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Mechatronics: Compulsory		
General Engineering Science (English program, 7 semester): Specialisation N	Mechanical	Engineering,
Focus Theoretical Mechanical Engineering: Compulsory		
Computational Science and Engineering: Core qualification: Compulsory		
Mechatronics: Core qualification: Compulsory		
Technomathematics: Specialisation III. Engineering Science: Elective Compulsor	ry	

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

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

Module M0680: F	luid Dynamics				
Courses					
Title	Тур	Hrs/v	wk	СР	
Fluid Mechanics (L0454)	Lecture	3		4	
Fluid Mechanics (L0455)	Recitation Section	(large) 2		2	
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechan	ics and thermo	odynam	iics.	
Educational Objectives	After taking part successfully, students have reached the following le	earning results			
Professional					
Competence					
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. Students can scientifically outline the rationale of flow physics using mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices.				
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis o technical systems. The lecture enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.				
Personal Competence					
	The students are able to discuss problems and jointly develop solution	on strategies.			
Social Competence					
Autonomy	The students are able to develop solution strategies for complex pr analyse results.	oblems self-co	nsisten	t and crticall	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
	Written exam				
Examination duration and scale	180 min				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectur Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectur 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				

ourse L0454: Fluid Me	chanics		
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	 Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows 		
Literature	 Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004 		

Course L0455: Fluid Me	urse 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: Multibody System		/ (Kinetics II,	Oscillations,	Analytical	Mechanics,
Courses					
Title Mechanics IV (Kinetics II, Os (L1137)	cillations, Analytical Mec	hanics, Multibody Systems)	Typ Lecture	Hrs/wk 3	СР 3
Mechanics IV (Kinetics II, Os (L1138) Mechanics IV (Kinetics II, Os (L1139)			Recitation Section		2
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
i	Mathematics I-III and I	Mechanics I-III			
Educational Objectives	After taking part succe	essfully, students have re	ached the following l	earning results	
Professional Competence	The students can				
Knowledge	 describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge. 				
Skills	 The students can explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic methods to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. 				
	The students can work	t in groups and support e of determining their ow those.			rganize their time
Workload in Hours	Independent Study Tir	ne 96, Study Time in Lec	ture 84		
Credit points	,				
Course achievement	CompulsorBonus No 20 %	Form Midterm	Description Wird nur im So	Se angeboten	
Examination					
Examination duration and scale	120 min				
Assignment for the Following Curricula	Compulsory General Engineering Compulsory General Engineering Compulsory Energy Systems: Tech General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory Mechanical Engineering Mechatronics: Core qu Naval Architecture: Co Technomathematics: S	Science (German progra Science (German progra Science (German prog nical Complementary Co Science (English progra Science (English progra Science (English prog ag: Core qualification: Con alification: Compulsory ore qualification: Compuls Specialisation III. Enginee cal Engineering: Techn	m, 7 semester): Spe ram, 7 semester): urse Core Studies: Ele n, 7 semester): Spe n, 7 semester): Spe ram, 7 semester): mpulsory sory ring Science: Elective	ecialisation Biomer Specialisation Na ective Compulsory cialisation Mechan cialisation Biomer Specialisation Na e Compulsory	dical Engineering aval Architecture nical Engineering dical Engineering aval Architecture

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	
Content	 Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab 	
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).	

ourse L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Recitation Section (small)		
2		
2		
Independent Study Time 32, Study Time in Lecture 28		
Prof. Robert Seifried		
DE		
SoSe		
See interlocking course		
See interlocking course		

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

Module M1277: M	IED I: Introduction to Anatom	у			
Courses					
Title Introduction to Anatomy (LC	384)	Typ Lecture	Hrs/wk 2	СР 3	
Module Responsible	Prof. Udo Schumacher				
Admission Requirements					
Recommended Previous Knowledge	None				
Educational Objectives	After taking part successfully, students hav	ve reached the following le	earning 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 o 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 current professional level.	discussions in biomedi	cal research and	medicine on	
Autonomy	The students are able to access anatomica on the topic and acquire the relevant know		es, can participate i	n conversatior	
Workload in Hours	Independent Study Time 62, Study Time in	Lecture 28			
Credit points	3				
Course achievement	None				
Examination					
Examination duration and scale	90 minutes				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective 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 Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsor Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsor Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory				

Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent St	udy Time 62, Study Time in Lecture 28		
Lecturer	Prof. Tobias Lar	ige		
Language	DE			
Cycle	SoSe			
	General Anato	omy		
	1 st week:	The Eucaryote Cell		
	2 nd week:	The Tissues		
	3 rd week:	Cell Cycle, Basics in Development		
	4 th week:	Musculoskeletal System		
	5 th week:	Cardiovascular System		
	6 th week:	Respiratory System		
Content	7 th week:	Genito-urinary System		
content	8 th week:	Immune system		
	9 th week:	Digestive System I		
	10 th week:	Digestive System II		
	11 th week:	Endocrine System		
	12 th week:	Nervous System		
	13 th week:	Exam		
		hael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016		

Title Typ Hrs/wk CP Introduction to Radiology and Radiation Therapy (L0383) Lecture 2 3 Module Responsible Prof. Ulrich Carl 2 3 Admission Requirements None 2 3 Recommended Previous Knowledge None 2 3 Educational Objectives After taking part successfully, students have reached the following learning results 5 Professional Competence Therapy The students can distinguish different types of currently used equipment with respect to its use radiation therapy. The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e.surgery, internal medicine). The students can describe the patients' passage from their initial admittance through the follow-up care. Diagnostics The students can illustrate the technical base concepts of projection radiography, includir angiography and mammography, as well as sterional imaging techniques (CT, MRT, US). The students can explain the diagnostic as well as therapeutic use of imaging techniques, as well as the technical basis for those techniques.	Courses					
Module Responsible Prof. Ulrich Carl Admission Requirements None Recommended Provious Knowledge None Educational Objectives After taking part successfully, students have reached the following learning results Provious Knowledge The students can distinguish different types of currently used equipment with respect to its use radiation therapy: The students can explain treatment plans used in radiation therapy in interdisciplinary contexts (e. surgery, internal medicine). The students can allustrate the technical base concepts of projection radiography, includir angiography and mammography, as well as sectional imaging techniques (CT, MRT, US). The students can explain the diagnostic as well as therapeutic use of imaging techniques, as well as technical basis for those techniques technical basis for those techniques. The students can distinguish curative and paliative situations and motivate why they came to th conclusion. The students can distinguish curative and paliative situations and motivate why they came to th social condition. The students can distinguish curative and paliative situations and motivate why they came to th conclusion. The students can distinguish curative and paliative situations and motivate why they came to th social formation inclusion of the tumor) and choses the energy needed in that situation (irradiation planning). SWMT SWMT The students can suggest solutions for repairs of imaging instrumentation affer having done err analyses.	Title	d Padiation Thorapy (10282)		-		
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Workload in Hours Independent Study Time 62, Study Time in Lecture 28						
	Autonomy				competently	
Credit points 3	Workload in Hours	Independent Study Time 62, Study Tim	ne in Lecture 28			
	Credit points	3				

Examination	Written exam			
Examination duration and scale	90 minutes			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory			
	Electrical Engineering: Specialisation Medical Technology: Elective Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory			
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering			
Following Curricula	Compulsory			
-	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective			
	Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Тур	Lecture
Hrs/wk	2
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Carl, Prof. Thomas Vestring
Cycle	
	The students will be given an understanding of the technological possibilities in the field medical imaging, interventional radiology and radiation therapy/radiation oncology. It 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) a therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big un 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
	 "Strahlentherapie und Onkologie f ür MTA-R" von R. Sauer –
	5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschier 08.12.2009
	ISBN: 978-3-437-47501-6
Literature	• "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoul
	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
	 "Praxismanual Strahlentherapie" von Stöver / Feyer –
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000

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Module M1279: M	IED II: Introduction to Bioch	nemistry and Molec	ular Biology	
Courses				
Title Introduction to Biochemistry	y and Molecular Biology (L0386)	Typ Lecture	Hrs/wk 2	СР 3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous Knowledge	None			
Educational Objectives	After taking part successfully, students	have reached the following le	earning results	
Professional Competence				
Knowledge	describe basic biomolecules:			
Skills	 The students can recognize the importance of mole describe selected molecular-diag explain the relevance of these pro- 	nostic procedures;	urse of a disease;	
Personal Competence				
Social Competence	The students can participate in discussion	ons in research and medicine	e on a technical level	
Autonomy	The students can develop understand themselves.	ling of topics from the cou	ırse, using technical	literature, k
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28		
Credit points	3			
Course achievement	None			
	Written exam			
Examination duration and scale	60 minutes			
Assignment for the Following Curricula	General Engineering Science (German Compulsory General Engineering Science (German Focus Biomechanics: Compulsory Data Science: Specialisation Medicine: C Electrical Engineering: Specialisation Medicine: C Engineering Science: Specialisation Bior General Engineering Science (English Compulsory General Engineering Science (English Focus Biomechanics: Compulsory Mechanical Engineering: Specialisation I Biomedical Engineering: Specialisation I Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation I Biomedical Engineering Biomedical Engineering Biomedical Engineering Biomedical Engine	program, 7 semester): Spec Compulsory edical Technology: Elective C medical Engineering: Compul program, 7 semester): Spec program, 7 semester): Spec Biomechanics: Compulsory Management and Business Ar on Artificial Organs and Medical Technology and Cont mplants and Endoprostheses	cialisation Mechanica compulsory lsory cialisation Biomedica cialisation Mechanica dministration: Elective Regenerative Medi trol Theory: Elective G	al Engineering al Engineering al Engineering e Compulsory cine: Electiv Compulsory

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

Module M1333: B	IO I: Implants and Fracture F	lealing		
Courses				
Title Implants and Fracture Heali	ng (L0376)	Typ Lecture	Hrs/wk 2	CP 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous Knowledge	It is recommended to participate in "In Fracture Healing".	troduction into Anatomie" bef	ore attending	"Implants and
Educational Objectives	After taking part successfully, students ha	ve reached the following learnin	g results	
Professional Competence				
Knowledge	The students can describe the different wa The students can name different treatm morphologies.			
Skills	The students can determine the forces a under specific assumptions.	acting within the human body	under quasi-s	static situations
Personal Competence				
Social Competence	The students can, in groups, solve basic nu	umerical modeling tasks for the	calculation of	internal forces.
Autonomy	The students can, in groups, solve basic nu	umerical modeling tasks for the	calculation of	internal forces.
Workload in Hours	Independent Study Time 62, Study Time ir	Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German pr Focus Biomechanics: Compulsory General Engineering Science (German pr Compulsory Engineering Science: Specialisation Biome General Engineering Science (English pro Compulsory General Engineering Science (English pro Focus Biomechanics: Compulsory Mechanical Engineering: Specialisation Bio Biomedical Engineering: Specialisation Bio Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Me Biomedical Engineering: Specialisation Me Biomedical Engineering: Specialisation Ma Orientierungsstudium: Core qualification: Engineering: Specialisation III. End	ogram, 7 semester): Specialisa dical Engineering: Compulsory ogram, 7 semester): Specialisa ogram, 7 semester): Specialisa mechanics: Compulsory Artificial Organs and Reger plants and Endoprostheses: Elec dical Technology and Control Th nagement and Business Adminis Elective Compulsory	tion Biomedic tion Biomedic tion Mechanic nerative Med tive Compulso eory: Elective stration: Elective	al Engineering: al Engineering: al Engineering, icine: Elective ry Compulsory

Hrs/wk 2 CP 3 Vorkload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Michael Morlock Language DE Cycle WiSe Topics to be covered include: 1. 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, ligame 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 5.1 Basics and biology of fracture repair 5.2 Clinical principals and terminology 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		
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6.0 New Implants Cochran V.B.: Orthopädische Biomechanik		
Cochran V.B.: Orthopädische Biomechanik		
Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics		
White A.A., Panjabi M.M.: Clinical biomechanics of the spine	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		

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
			-	-
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in ti	me and frequency domain, Laplac	ce transform	
Educational Obiectives		e reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic sy particular explain properties of first a They can explain the dynamics of sin of frequency response and root locus They can explain the Nyquist stabilit They can explain the role of the phase They can explain the way a PID of response They can explain issues arising we implemented digitally 	and second order systems mple control loops and interpret of s y criterion and the stability margi se margin in analysis and synthes controller affects a control loop	lynamic prop ns derived fi is of control in terms o	perties in terr rom it. loops f its frequen
Skills	 Students can transform models of livice versa They can simulate and assess the be They can design PID controllers with They can analyze and synthesize sir response techniques They can calculate discrete-time apuse it for digital implementation They can use standard software too tasks 	chavior of systems and control loc the help of heuristic (Ziegler-Nich nple control loops with the help o proximations of controllers design	ops hols) tuning of root locus ned in contin	rules and frequen nuous-time a
Personal Competence				
Social Competence	Students can work in small groups to jointly controller designs	y solve technical problems, and e	xperimental	y validate the
	Students can obtain information from p experiment guides) and use it when solving	rovided sources (lecture notes,		
Autonomy	They can assess their knowledge in weekly	on-line tests and thereby control	their learnir	ng progress.
Workload in Hours	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German prog Bioprocess Engineering: Core qualification: Computer Science: Specialisation Computa Data Science: Core qualification: Elective C Electrical Engineering: Core qualification: C Energy and Environmental Engineering: Co General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory General Engineering Science (English pro Compulsory General Engineering Science (English prog Engineering: Compulsory General Engineering Science (English prog Engineering: Compulsory General Engineering Science (English prog	Compulsory tional Mathematics: Elective Com ompulsory ompulsory re qualification: Compulsory ogram, 7 semester): Specialisat program, 7 semester): Specialisatio gram, 7 semester): Specialisation	pulsory tion Electrica lisation Civion Bioproces n Energy an	al Engineerir il Engineerir 55 Engineerir d Enviromen

	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
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	Focus Aircraft Systems Engineering: Compulsory
i onoming curriculu	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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 gualification: Compulsory
	Trocess Engineering. Core quainedation. Compaisory

Course 0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
-	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	DE
Cycle	
	 Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability
	 Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle
	Root locus techniques Root locus plots Root locus design of PID controllers Frequency response techniques
Content	 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addisor Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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

Module M0684: H	eat Transfer					
Courses						
Title	Тур	-	Hrs/wk	СР		
Heat Transfer (L0458) Heat Transfer (L0459)		ture citation Section (large)	3 2	4 2		
	Dr. Andreas Moschallski		-	-		
Admission						
Requirements	None					
Recommended Previous Knowledge	Technical Thermodynamics I, II and Fluid Dynamics					
Educational Objectives	After taking part successfully, students have reached t	he following learning r	esults			
Professional Competence						
	The students are able to					
	- describe the different physical mechanism of Heat Tra	ansfer,				
Knowledge	- explain the technical terms,					
	- to analyse comlex heat transfer processes in a critica	ıl way.				
	The students are able to					
	- understand the physics of Heat Transfer,					
Skills						
	- solve excersises self-consistent and in small groups.					
Personal Competence						
Social Competence	The students are able to discuss in small groups and de	evelop an approach.				
Autonomy	The students are able to develop a complex problem s way. A qualified exchange with other students is given		lyse the res	ults in a critic		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points						
Course achievement	None					
Examination	Written exam					
Examination duration and scale	120 min					
Assignment for the Following Curricula	General Engineering Science (German program, 7 se Focus Energy Systems: Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Focus Theoretical Mechanical Engineering: Elective Cor General Engineering Science (German program, 7 se Focus Theoretical Mechanical Engineering: Compulsory Energy Systems: Technical Complementary Course Cor General Engineering Science (English program, 7 se Focus Theoretical Mechanical Engineering: Elective Cor General Engineering Science (English program, 7 se	emester): Specialisatio emester): Specialisation mpulsory emester): Specialisation re Studies: Elective Con mester): Specialisation mpulsory	n Biomedic n Mechanic n Mechanic mpulsory n Mechanic	al Engineering al Engineering al Engineering al Engineering		

Course L0458: Heat Tra	ansfer
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	Dimensional analysis, Heat Conduction (steady and unsteady), Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux
Literature	 Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996

Course L0459: Heat Tra	urse 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		

6					
Courses					
Title Embodiment Design and 3D	-CAD (L0268)		Typ Lecture	Hrs/wk 2	CP 1
Mechanical Design Project I	(L0695)		Project-/problem-based Learning	3	2
Mechanical Design Project I	(L0592)		Project-/problem-based Learning	3	2
Team Project Design Metho	dology (L0267)		Project-/problem-based Learning	2	1
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
Requirements					
Recommended	 Fundamentals Mechanics 	of Mechanical Engineering	Design		
Previous Knowledge	 Fundamentals 	of Materials Science			
	 Production Eng 	Jineering			
Educational Objectives	After taking part succ	essfully, students have rea	ched the following learning	results	
Professional					
Competence		dule, students are able to:			
			/ parts e.g. considering lo	ad cituation	matorials a
Knowledge			parts e.g. considering it	au situation	, materials al
	describe basics	-	cionina		
	 explain basics 	methods of engineering de	signing.		
	After passing the mod	dule, students are able to:			
	 independently 	create sketches, technical	drawings and documentati	ons e.g. using	g 3D CAD,
Skills	3	nents based on design guid culate) used components,	elines autonomously,		
			ring design tasks systamtic	ally and solu	tion-oriented,
		y techniques in teams.			
Personal Competence					
	After passing the mod	dule, students are able to:			
	 develop and ev 	valuate solutions in groups	including making and docu	menting deci	isions,
Social Competence		use of scientific methods,		5	
		scuss solutions and technic results in the work groups			
	Students are able				
Autonomy	 to estimate t clickers), 	heir level of knowledge us	sing activating methods v	vithin the lec	tures (e.g. wi
		eering design tasks system	atically.		
Warkload in Hours	Indonondont Study Ti	me 40, Study Time in Lect	uro 140		
Credit points	,	ine 40, Study fille in Lecti	JIE 140		
	 Compulsor ₿ onus	Form	Description		
	Yes None	Written elaboration	Teamprojekt Konstruk	tionsmethodi	k
Course achievement		Written elaboration	Konstruktionsprojekt 1		
	Yes None Yes None	Written elaboration Written elaboration	Konstruktionsprojekt 2 3D-CAD-Praktikum		
Examination	Written exam		SD-CAD-Plakukuili		
Examination Examination duration					
and scale	180				
		Science (German program	n, 7 semester): Specialisat	ion Mechanic	cal Engineerin
	Compulsory General Engineering	Science (German program	n, 7 semester): Specialisat	ion Biomedia	cal Engineerin
	Compulsory				
	General Engineering Engineering: Compute		, 7 semester): Specialisati	on Energy ar	nd Enviroment
		sory Igineering: Core qualificatio	n: Compulsory		
	Energy and Environm	ental Engineering: Core gu	alification: Compulsory		
Acciement for the		a i i i i i		_	
Assignment for the Following Curricula	General Engineering	Science (English program,	7 semester): Specialisatio	on Energy ar	nd Enviroment

Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

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

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

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

Course L0267: Team Pr	oject Design Methodology
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	 Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides
Literature	 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, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Courses						
Fitle Practical Course: Measurem Measurement Technology fo Measurement Technology fo	or Mechanical Engineering	g (L1116)		Typ Practical Course Lecture Recitation Section (large)	Hrs/wk 2 2 1	CP 2 3 1
Module Responsible						
Admission						
Requirements						
Recommended Previous Knowledge	Basic knowledge of phy	ysics, chemistry an	d electri	cal engineering		
ducational Objectives	After taking part succe	ssfully, students ha	ave reac	ned the following learning	results	
Professional Competence	Students are able to na			idmentals of the Measurer		
Knowledge	They can outline the maesured (Electrical Q	and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems). They can outline the most important measuring methods for different kinds of quantities to t maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency). They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Ga Chromatography)				
Skills	devices in practice. The students are able	e to orally explain	issues i	to given problems and car n the subject area of me to the right context and ap	asurement	technology a
Personal Competence						
Social Competence		work results in gro	ups and	document them in a comr	non report.	
Autonomy	Students are able to fa	miliarize themselv	es with n	ew measurement technol	ogies.	
	Independent Study Tim	ne 110, Study Time	in Lectu	ire 70		
Credit points	-	Earm		Description		
Course achievement	Compulsor B onus Yes None	Form Subject theore practical work	tical a	Description nd		
	Written exam					
Examination duration and scale	105 minutes					
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulso Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory General Engineering S Compulsory	Science (German p incering: Core qual intal Engineering: C ipecialisation Mech ipecialisation Mech ipecialisation Biome icience (English pr iscience (English pr iscience (English pr iscience (English pr iscience (English pr iscience (English pr iscience (English pr	rogram, rogram, lification Core qual atronics: anical Er edical En ogram, T rogram, rogram, gram, 7 rogram,	ification: Compulsory	on Biomedia In Energy ar Ilsory n Energy ar on Mechanic on Biomedia Mechatronic: on Mechanic	cal Engineeri nd Enviromer nd Enviromer cal Engineeri cal Engineeri s: Compulsor cal Engineeri

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

urse L1116: Measure	ement Technology for Mechanical Engineering
Тур	Lecture
Hrs/wk	2
СР	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Thorsten Kern, Dennis Kähler
Language Cycle	
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
Content	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	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
	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: 978 3486217940.

ourse L1118: Measurement Technology for Mechanical Engineering		
Recitation Section (large)		
l		
l		
ndependent Study Time 16, Study Time in Lecture 14		
Prof. Thorsten Kern		
EN		
NiSe		
See interlocking course		
See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (L0	0417)	Lecture	2	3
Numerical Mathematics I (L0	0418)	Recitation Section (small)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	 Mathematik I + II for Engineering Stud for Technomathematicians basic MATLAB knowledge 	ents (german or english) or Ana	alysis & Line	ar Algebra I +
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional				
Competence				
	Students are able to			
Knowledge	 name numerical methods for interp problems, nonlinear root finding proble repeat convergence statements for the explain aspects for the practical exec and storage complexitx. 	ems and to explain their core id e numerical methods,	eas,	
	Students are able to			
Skills	 implement, apply and compare numer justify the convergence behaviour of solution algorithm, select and execute a suitable solution 	f numerical methods with re	spect to the	e problem an
Personal Competence				
	Students are able to			
Social Competence	 work together in heterogeneously con and background knowledge), explain practical aspects regarding the implent 	n theoretical foundations and		
	Students are capable			
Autonomy	 to assess whether the supporting individually or in a team, to assess their individual progess and, 			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement	None			
Examination				
Examination duration	90 minutes			
and scale	General Engineering Science (German pr	ogram 7 semester): Speciali	sation Com	nuter Science
	Compulsory General Engineering Science (German prog Focus Materials in Engineering Sciences: Con General Engineering Science (German prog Compulsory General Engineering Science (German prog Focus Biomechanics: Compulsory General Engineering Science (German prog Focus Theoretical Mechanical Engineering: C Bioprocess Engineering: Specialisation A - Ge Computer Science: Specialisation Computatio Computer Science: Specialisation II. Mathema Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Ele	npulsory ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ram, 7 semester): Specialisatio ompulsory meral Bioprocess Engineering: E onal Mathematics: Elective Com atics and Engineering Science: E	on Biomedic on Mechanic on Mechanic Elective Com pulsory	al Engineering al Engineering al Engineering apulsory
Assignment for the Following Curricula	Engineering Science: Core qualification: Com General Engineering Science (English progr Focus Theoretical Mechanical Engineering: El General Engineering Science (English progra General Engineering Science (English pro	am, 7 semester): Specialisatic ective Compulsory n, 7 semester): Core qualificati	on: Compuls	ory

Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Biomechanics: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Materials in Engineering Sciences: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin	eering,
Focus Theoretical Mechanical Engineering: Compulsory	
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engine	eering:
Compulsory	
Computational Science and Engineering: Core qualification: Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory	
Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	
Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory	
Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: E	lective
Compulsory	
Process Engineering: Specialisation Process Engineering: Elective Compulsory	

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

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

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Module M0634: Ir	ntroduction i	nto Medical Te	chnology and Syste	ms	
Courses					
Title Introduction into Medical Te Introduction into Medical Te Introduction into Medical Te	chnology and System	ns (L0343)	Typ Lecture Project Seminar Recitation Section (Hrs/wk 2 2 large) 1	CP 3 2 1
Module Responsible	Prof. Alexander Scl	nlaefer			
Admission Requirements	None				
Recommended Previous Knowledge	principles of stoch	(algebra, analysis/ca astics amming, R/Matlab	lculus)		
Educational Objectives	After taking part su	uccessfully, students	have reached the following lea	arning results	
Professional Competence		and the second state of the			
Knowledge	current and modi	cal information syste	medical technology, including ms. They are able to give an		
Skills		ble to evaluate syste	ms and medical devices in the	e context of clinica	l applications.
Personal Competence Social Competence	The students desc	ribe a problem in me	dical technology as a project, a	and define tasks tl	nat are solved
	The students can reflect their knowledge and document the results of their work. They can present th results in an appropriate manner.				
Workload in Hours	Independent Study	Time 110, Study Tir	ne in Lecture 70		
Credit points	6				
Course achievement	CompulsorBonusYes10 %Yes10 %	5 Form Written elabora Presentation	Description ation		
	Written exam				
Examination duration and scale	90 minutes				
Assignment for the Following Curricula	Compulsory Computer Science: Data Science: Core Electrical Engineer Engineering Science General Engineerin Compulsory Computational Scie Computational Scie Computational Scie Biomedical Engin Compulsory	Specialisation Comp Specialisation II. Ma qualification: Electiv ing: Core qualificatio es: Specialisation Bio ng Science (English ence and Engineering ence and Engineering ence and Engineering eering: Specialisation	program, 7 semester): Spec outer and Software Engineering thematics and Engineering Sci ve Compulsory n: Elective Compulsory medical Engineering: Compuls program, 7 semester): Speci g: Specialisation II. Mathemation g: Specialisation Computer Scie g: Specialisation Engineering S on Artificial Organs and F Implants and Endoprostheses:	g: Elective Compul ience: Elective Cor ory alisation Biomedi cs & Engineering S ence: Elective Con ciences: Elective Con Regenerative Med	sory npulsory cal Engineering ccience: Electiv ppulsory compulsory dicine: Electiv

Course L0342: Introduc	tion 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	 imaging systems computer aided surgery medical sensor systems medical information systems regulatory affairs standard in medical technology The students will work in groups to apply the methods introduced during the lecture using problem based learning.
Literature	Wird in der Veranstaltung bekannt gegeben.

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

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

Courses				
Title		Тур	Hrs/wk	СР
Experimental Methods in Bio	omechanics (L0377)	Lecture	2	3
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	It is recommended to participate Methoden".	in "Implantate und Frakturheilung"	before attending "Ex	kperimente
Educational Objectives	After taking part successfully, stu	dents have reached the following lea	arning results	
Professional Competence				
Knowledge	The students can describe the different ways how bones heal, and the requirements for their existence The students can name different treatments for the spine and hollow bones under given fracture morphologies. 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 th biomechanics.	e basic handling of several ex	kperimental techniqu	ues used
Personal Competence				
Social Competence	The students can, in groups, solve	e basic experimental tasks.		
Autonomy	The students can, in groups, solve	e basic experimental tasks.		
Workload in Hours	Independent Study Time 62, Stud	y Time in Lecture 28		
Credit points	3			
Course achievement	None			
Examination				
Examination duration and scale	90 min			
_	Focus Biomechanics: Compulsory General Engineering Science (Ge Compulsory Engineering Science: Specialisatic General Engineering Science (En Focus Biomechanics: Compulsory General Engineering Science (En Compulsory General Engineering Science (En Elective Compulsory Mechanical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis Biomedical Engineering: Specialis	alisation Artificial Organs and F ation Implants and Endoprostheses: ation Medical Technology and Contr ation Management and Business Ad	ialisation Biomedical Compulsory alisation Mechanical ialisation Biomedical alisation Biomedical Regenerative Medici Elective Compulsory of Theory: Elective Com ministration: Elective	Engineerir Engineerir Engineerir Engineerir ne: Electi
	Technomathematics: Specialisatic	In m. Engineering Science. Elective	1 ,	
Course L0377: Experim				
	Technomathematics: Specialisatio			
	Technomathematics: Specialisation			
Тур	Technomathematics: Specialisatic ental Methods in Biomechanics Lecture 2			
Typ Hrs/wk CP	Technomathematics: Specialisatic ental Methods in Biomechanics Lecture 2	S		

Courses				
Title Management Tutorial (L088 Introduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements				
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have reac	hed the following learning	results	
Professional Competence	After taking this module, students know the imp	ortant basics of many diffe	aront aroas i	n Rusinoss a
Knowledge	 Management, from Planning and Organisation to Controlling. In particular they are able to explain the differences between Econo Management and to name important defini explain the most important aspects of and aspects of entreprneurial projects describe and explain basic business function chain management, organization and hum innovation management and marketing explain the relevance of planning and dimultiple objectives and uncertainty, and Finance state basics from accounting and costing and 	mics and Management a itions from the field of Man d goals in Management and ions as production, procure an ressource management ecision making in Busines d explain some basic me	and the su agement d name the ement and s c, information cs, esp. in s ethods from	b-disciplines most importa ourcing, supp n managemen ituations und
Skills	 Students are able to analyse business units with strategies etc.) and to carry out an Entrepreneurs analyse Management goals and structure t analyse organisational and staff structures apply methods for decision making under r analyse production and procurement syste analyse and apply basic methods of marke select and apply basic methods from math apply basic methods from accounting, cost 	ship project in a team. In pa chem appropriately of companies multiple objectives, under u ms and Business information ting ematical finance to predefi	articular, the incertainty a on systems ned problem	y are able to ind under risk
Personal Competence				
Social Competence	 Students are able to work successfully in a team of students to apply their knowledge from the lecture report on the project to communicate appropriately and to cooperate respectfully with their fellow set on the statement of the sta		roject and w	vrite a cohere
Autonomy	 Students are able to work in a team and to organize the team the to write a report on their project. 	hemselves		
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, 7 Civil- and Environmental Engineering: Core qualif Civil- and Environmental Engineering: Specialisat Civil- and Environmental Engineering: Specialisat Civil- and Environmental Engineering: Specialisat Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compul Energy and Environmental Engineering: Core qua	ication: Compulsory ion Civil Engineering: Electi ion Water and Environment ion Traffic and Mobility: Ele ulsory y sory	ve Compulso : Elective Co	ory ompulsory

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	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	
Following Curricula	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 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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core gualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
I	Process Engineering: Core qualification: Compulsory

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

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

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Courses				
Title Introduction to Physiology (I	L0385) Typ Hrs/wk CP Lecture 2 3			
	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	The students can			
Knowledge	 describe the basics of the energy metabolism; describe physiological relations in selected fields of muscle, heart/circulation, neuro- and sensor physiology. 			
SKIIIS	The students can describe the effects of basic bodily functions (sensory, transmission and processing information, development of forces and vital functions) and relate them to similar technical systems.			
Personal Competence				
Social Competence	The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrological			
Autonomy	The students can derive answers to questions arising in the course and other physiological areas, usi technical literature, by themselves.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Course achievement	None			
Examination				
Examination duration and scale	60 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Elective Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory			

Course L0385: Introduc	tion to Physiology			
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Gerhard Engler, Dr. Gerhard Engler			
Language)E			
Cycle	õe			
Content				
	Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme			
Literature	Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier			

Specialization Naval Architecture

The Bachelor Course "Naval Architecture" prepares by the elective modules for scientific tasks in naval architecture, ocean engineering and related mechanical engineering disciplines. Thus, the occupational orientation can either related to the design of ships or offshore systems, or to more dedicated areas, such as hydrodynamics or strength of structures.

Courses				
Title	ame (10654)	Тур	Hrs/wk	CP
ntroduction to Control Syste Introduction to Control Syste		Lecture Recitation Section (sma	2 II) 2	4 2
-			, _	_
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	Representation of signals and sys	stems in time and frequency domain, La $_{ m i}$	place transforn	n
ducational Objectives	After taking part successfully, stu	idents have reached the following learni	ng results	
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally 			
Skills	 Students can transform models of linear dynamic systems from time to frequency domain ar vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequence response techniques They can calculate discrete-time approximations of controllers designed in continuous-time ar use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks 			
Personal Competence				
	Students can work in small group controller designs	s to jointly solve technical problems, an	d experimenta	lly validate th
	Students can obtain informatio experiment guides) and use it wh	n from provided sources (lecture no nen solving given problems.	tes, software	documentatio
Autonomy	They can assess their knowledge	in weekly on-line tests and thereby con	rol their learni	ng progress.
Workload in Hours	Independent Study Time 124, Stu	udy Time in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
	Compulsory	German program, 7 semester): Spec erman program, 7 semester): Specialis		

	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
Assignment for the Following Curricula	Compulsory
r onowing curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core gualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory
	Process Engineering: Core qualification: Compulsory

Course L0654: Introduc	tion to Control Systems
	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus plots Reforment etachniques 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

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			Tun	Hrs/wk	СР
Computer Engineering (L03	21)		Typ Lecture	пгs/wк 3	4
Computer Engineering (L03			Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk				
Admission					
Requirements					
Recommended Previous Knowledge	Basic knowledge in electri	ical engineering			
		ully, students have rea	ched the following learning	results	
Professional		•			
Competence					
			unctionality of computing sy gates. The module includes t		
					cop.co.
	 Introduction Combinational loc 	gic: Gates, Boolean	algebra, Boolean function	ons, hardwa	are synthes
	combinational netw	vorks			,
Knowledge	 Sequential logic: Fi Technological found 		tematic hardware design		
	 Computer arithmet 	ic: Integer addition, su	btraction, multiplication and		
		architecture: Program hierarchies, SRAM, DF	ming models, MIPS single-cy RAM, caches	cle architect/	ure, pipelinir
	 Input/output: I/O f 	rom the perspective	of the CPU, principles of p	assing data	, point-to-po
	connections, busse	S			
	The students perceive c	computer systems fro	m the architect's perspect	ive, i.e., the	ey identify t
	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 simp components. They are able to distinguish between and to explain the different abstraction layers				
	today's computing systems - from gates and circuits up to complete processors.				
Skills	s After successful completion of the module, the students are able to judge the interdependencies				
			he software executed on it		
			on of software has on the h gates. This way, they will b		
	•	bstraction levels have	e on an entire system's pe	rformance a	nd to propo
	feasible options.				
Personal Competence					
Social Competence	Students are able to solve	e similar problems alon	e or in a group and to prese	nt the result	s accordingly
	Students are able to acq	uire new knowledge fr	om specific literature and t	o associate	this knowled
Autonomy	with other classes.	Ū.			
Workload in Hours	Independent Study Time 3	124 Study Time in Lec	ture 56		
Credit points					
•	CompulsorBonus F	orm	Description		
Course achievement		xcercises	• • •		
Examination	Written exam				
Examination duration	90 minutes, contents of c	ourse and labs			
and scale			an 7 comostor). Crociali	ication Com	nutor Colony
	Compulsory	lence (German progr	am, 7 semester): Speciali	Isation Com	puter Scienc
	General Engineering Scie	ence (German program	n, 7 semester): Specialisatio	on Bioproces	s Engineerin
	Compulsory General Engineering Sci	ence (German progr	am, 7 semester): Speciali	sation Nava	l Architectu
	Compulsory				
	General Engineering Sc Compulsory	ience (German prog	ram, 7 semester): Specia	lisation Civi	I Engineerir
	General Engineering Scie	ence (German progra	m, 7 semester): Specialisat	tion Electrica	al Engineerir
	Compulsory General Engineering Scie	nce (German program	n, 7 semester): Specialisatio	on Biomedic	al Engineerir
	Compulsory	are (German proyfall	i, i semesteri, specialisatio		ar Engineerif
	General Engineering Scie	nce (German program	, 7 semester): Specialisation	n Energy an	d Enviroment
	Engineering: Compulsory General Engineering Scie	ence (German progra	ım, 7 semester): Specialisa	ation Proces	s Engineerir
	Compulsory		· · ·		5
			n, / semester): Specialisatio	on Mechanic	aı Engineerir
	Compulsory	nce (German program	im, 7 semester): Specialisatio		0

	eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Biomechanics: Compulsory
	eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Aircraft Systems Engineering: Compulsory
	eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Materials in Engineering Sciences: Compulsory
	eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Theoretical Mechanical Engineering: Compulsory
	eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Product Development and Production: Compulsory
	eneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,
	ocus Energy Systems: Compulsory
	omputer Science: Core qualification: Compulsory
Assignment for the	lectrical Engineering: Core qualification: Compulsory
Following Curricula	eneral Engineering Science (English program, 7 semester): Specialisation Computer Science: ompulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:
	ompulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	ompulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Civil Engineering:
	ompulsory
G	eneral Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
Co	ompulsory
G	eneral Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	ompulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental
	ngineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Process 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 Biomechanics: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Aircraft Systems Engineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Materials in Engineering Sciences: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Theoretical Mechanical Engineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Product Development and Production: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Energy Systems: Compulsory
	omputational Science and Engineering: Core qualification: Compulsory
	lechatronics: Core qualification: Compulsory
Te	echnomathematics: Specialisation II. Informatics: Elective Compulsory

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

Course L0324: Compute	urse 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		

ourses				
Fitle Management Tutorial (L0882 htroduction to Management		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
			5	5
Module Responsible Admission				
Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and	Business		
,	After taking part successfully, studen	ts have reached the following learning	results	
Professional Competence				
Knowledge	 After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management and marketing 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 state basics from accounting and costing and selected controlling methods. 			
	 strategies etc.) and to carry out an Er analyse Management goals an analyse organisational and sta apply methods for decision ma analyse production and procur analyse and apply basic method select and apply basic method 	nts are able to analyse business units with respect to different criteria (organization, objectives, gies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems		
Personal Competence				
	Students are able to			
Social Competence	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherer report on the project to communicate appropriately and to cooperate respectfully with their fellow students. 			
	Students are able to			
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 ⁻	Fime in Lecture 70		
Credit points	· · · · ·			
Course achievement				
	Subject theoretical and practical worl	<		
Examination duration	several written exams during the sen			
 	General Engineering Science (Germ	an program, 7 semester): Specialisa	tion Electric	al Engineering
	Compulsory			
	General Engineering Science (Gern Compulsory	nan program, 7 semester): Specialis	ation Proces	s Engineering
		an program, 7 semester): Specialisati	on Biomedic	al Engineering
		nan program, 7 semester): Speciali		

	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, 7 semester): Specialisation Electrical Engineering:
r onowing curricula	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,
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Product Development and Production: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
	Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory
	Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Orientierungsstudium: Core qualification: Elective Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

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

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

Courses						
Title		Тур	Hrs/wk	СР		
	rtial Differential Equations) (L1043)	Lecture	2	1		
Differential Equations 2 (Pa	rtial Differential Equations) (L1044)	Recitation Section (small)	1	1		
	rtial Differential Equations) (L1045)	Recitation Section (large)	1	1		
Complex Functions (L1038) Complex Functions (L1041)		Lecture Recitation Section (small)	2 1	1 1		
Complex Functions (L1042)		Recitation Section (large)	1	1		
Module Responsible	Prof. Anusch Taraz					
Admission	None					
Requirements Recommended						
Previous Knowledge						
Educational Objectives	After taking part successfully, students have	ve reached the following learning	results			
Professional Competence						
competence						
	Students can name the basic conce	epts in Mathematics IV. They are	able to expl	ain them usin		
	appropriate examples.Students can discuss logical cont	nections between these concen	ts Thev	are capable (
Knowledge	illustrating these connections with t	he help of examples.	to. They	are capable		
	They know proof strategies and can	reproduce them.				
	Students can model problems in M	lathematics IV with the help of th	he concepts	studied in th		
	course. Moreover, they are capable					
	 Students are able to discover and studied in the course. 	d verify further logical connection	ons betwee	n the concep		
Skills	 For a given problem, the students call 	an develop and execute a suitable	e approach,	and are able		
	critically evaluate the results.					
Personal Competence						
	• Students are able to work together i	in teams. They are capable to use	mathematio	cs as a commo		
	language.In doing so, they can communicate new concepts according to the needs of their cooperating					
Social Competence	partners. Moreover, they can desig					
	peers.					
	Students are capable of checking t	heir understanding of complex co	oncepts on	their own. The		
	can specify open questions precisely and know where to get help in solving them.					
Autonomy	 Students have developed sufficient persistence to be able to work for longer periods in a goal- oriented manner on hard problems. 					
	enerice munici on nare problems.					
	Independent Study Time 68, Study Time in Lecture 112					
Credit points						
Course achievement	None Written exam					
Examination duration						
and scale	160 min (Complex Functions) + 60 min (Diff	ferential Equations 2)				
	General Engineering Science (German p	rogram, 7 semester): Specialisat	tion Electric	al Engineerin		
	Compulsory General Engineering Science (German pro	ogram 7 semester). Specialisatio	n Mechanic	al Engineering		
	Focus Mechatronics: Compulsory	ogram, / semester). specialisatio	AT MECHANIC	ar Engineening		
	General Engineering Science (German pro		on Mechanic	al Engineering		
	Focus Theoretical Mechanical Engineering:		cation No.	al Architactur		
	General Engineering Science (German Compulsory	program, / semester): Speciali	sauun NaVa	ai Architectur		
	Computer Science: Specialisation Compute		pulsory			
	I Floor deal Food and deal Company life and an o	Camage 1.1 a a m 1				
	Electrical Engineering: Core qualification: Constraints Engineering		ion Flatt			
	General Engineering Science (English pr Compulsory		ion Electric	al Engineerin		

Assignment for the	
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Theoretical Mechanical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:
	Compulsory
	Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective
	Compulsory
	Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory
	Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Mechanical Engineering: Specialisation Mechatronics: Compulsory
	Mechatronics: Core gualification: 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	 Main features of the theory and numerical treatment of partial differential equations Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements 	
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 	

Course L1044: Differen	ourse 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	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	Main features of complex analysis Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation 		
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 		

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

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

Module M0960: Multibody System		/ (Kinetics II,	Oscillations,	Analytical	Mechanics,
Courses					
Title Mechanics IV (Kinetics II, Os (L1137)	Title Typ Hrs/wk CP Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) Locture 3 3				
Mechanics IV (Kinetics II, Os (L1138)	cillations, Analytical Mec	hanics, Multibody Systems)	Recitation Section	(small) 2	2
Mechanics IV (Kinetics II, Os (L1139)	cillations, Analytical Mec	hanics, 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 succ	essfully, students have rea	ached the following l	earning results	
Professional Competence					
Knowledge	• describe the ax	iomatic procedure used ir ant steps in model design; al knowledge.		s;	
Skills	 The students can explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic methods to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. 				
Social Competence	The students can wor	k in groups and support ea of determining their owr h those.			rganize their tim
Workload in Hours	Independent Study Ti	me 96. Study Time in Lect	ure 84		
Credit points		ne 50, 5tudy fille in Leet			
Course achievement	CompulsorBonus	Form Midterm	Description Wird nur im Sos	Se angeboten	
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Compulsory General Engineering Compulsory General Engineering Compulsory Energy Systems: Tech General Engineering Compulsory General Engineering Compulsory General Engineering Compulsory Mechanical Engineering Mechatronics: Core qu Naval Architecture: Co Technomathematics:	Science (German program Science (German program Science (German program Inical Complementary Cou Science (English program Science (English program Science (English program Science (English program Ing: Core qualification: Com Jalification: Compulsory Specialisation III. Engineer cal Engineering: Technic	m, 7 semester): Spe ram, 7 semester): Irse Core Studies: Ele n, 7 semester): Spe am, 7 semester): Spe am, 7 semester): npulsory ory ring Science: Elective	cialisation Biome Specialisation Na ective Compulsory cialisation Mechan cialisation Biomea Specialisation Na e Compulsory	dical Engineering aval Architecture nical Engineering dical Engineering aval Architecture

Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	
Content	 Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab 	
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012).	

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

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

Module M0680: F	luid Dynamics		
Courses			
Title	Тур	Hrs/wk	СР
Fluid Mechanics (L0454)	Lecture	3	4
Fluid Mechanics (L0455)	Recitation Section (larg	e) 2	2
Module Responsible			
Admission Requirements	None		
Recommended Previous Knowledge	Sound knowledge of engineering mathematics, engineering mechanics a	nd thermodyna	mics.
Educational Objectives	After taking part successfully, students have reached the following learn	ng results	
Professional			
Competence		l principles of f	uid anainearin
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. Students can scientifically outline the rationale of flow physics using mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices.		
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis o technical systems. The lecture enables the student to carry out all necessary theoretical calculation for the fluid dynamic design of engineering devices on a scientific level.		
Personal Competence			
	The students are able to discuss problems and jointly develop solution st	rategies.	
Social Competence			
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement			
	Written exam		
Examination duration and scale	180 min		
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (English program, 7 semester): Specialis Compulsory Computational Science and Engineering: Specialisation Engineering Science Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Core	sation Biomedia cialisation Nav ation Mechanic cation Biomedia cialisation Nav nces: Elective C	cal Engineering al Architecture cal Engineering cal Engineering al Architecture

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

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

Courses				
Title		Тур	Hrs/wk	СР
Ship Structural Design (L04		Lecture	2	3
Ship Structural Design (L04)		Recitation Section (small)	2	3
Welding Technology (L1123	·	Lecture	3	3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	Students can reproduce design and sizing as well as fabrication of the different areas of ship structur and of different ship types (incl. detail design); they can describe calculation models for compl structures. e			
Skills	Students are capable to specify the requirements for different ship types and areas of the hull, to defi design criteria for the components, to select suitable calculation models and to assess the chose structure			
Personal Competence				
Social Competence	Students are capable to present their s group.	structural design and discuss their d	ecisions cor	structively in
	Students are capable to design indepe ship types and to define appropriate fat		the ship hu	Ill and differ
Autonomy				
Workload in Hours	Independent Study Time 172, Study Tin	ne in Lecture 98		
Credit points				
Course achievement	None			
	Written exam			
Examination duration and scale	3 hours			
Assignment for the Following Curricula				

Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

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

Course L1123: Welding	Technology
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	 phase transitions, phase diagrams and thermal activated processes fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams properties of weldable carbon and fine grained steels properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels structure and properties of non-ferrite metals (aluminum, titanium) NDT/DT Methods for materials and welds gas fusion welding, fundamentals of electric arc welding technologies structure and influence parameters for the welded joint submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding resistance welding/ polymer welding/ hybrid-welding electron beam welding/ laser beam welding weld joint designs and declarations computation methods for weld joint dimensioning
Literature	 Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005. Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Module M0659: F	undamentals of Ship Structura	l Design and Analysis	5	
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Ship Struc	tural Design (L0411)	Lecture	2	2
undamentals of Ship Struc	-	Recitation Section (small)	1	2
undamentals of Ship Struc		Lecture	2	2
Fundamentals of Ship Struc	tural Analysis (L0414)	Recitation Section (small)	1	2
Module Responsible				
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	reached the following learning	results	
Professional		j		
Competence				
	Students can reproduce the basic contents of the structural behaviour of ship structures; they ca explain the theory and methods for the calculation of deformations and stresses in beam-lik structures.			
Knowledge	^e Furthermore, they can reproduce the basis contents of codes (rules), materials, semi-finished produc joining and principles of structural design of components in the ship structure.		ished product	
ci-iu-	Students are capable of applying the method stresses in the above mentioned structure structures.	es; they can choose calculati	on models	of typical sh
SKIIIS	Furthermore, they are capable to apply the n select suitable materials, semi-finished produ		he ship stru:	cture; they ca
Personal Competence				
Social Competence	The students are able to communicate and c and component supply industry.	ooperate in a professional envi	ronment in t	he shipbuildir
	The students are capable to independently in for analysis of beam-like structures; they are			
Autonomy	Furthermore, they are capable to assess of structures for various requirements and bour		ctures and	to design shi
Workload in Hours	Independent Study Time 156, Study Time in	Lecture 84		
Credit points				
Course achievement				
	Written exam			
Examination duration				
and scale				A such that
Assignment for the Following Curricula		ogram, 7 semester): Speciali		

Course L0411: Fundamentals of Ship Structural Design		
Тур	Lecture	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Chapters: 1. Introduction 3. Class societies and their tasks 4. Materials for steel shipbuilding 5. Welding and Cutting 6. Semi-finished products in steel shipbuilding 7. Determining the scantlings for local loads 8. Longitudinal strength of the hull girder 9. Determining the scantlings of longitudinal structural members 10. Determining the scantlings of bottom and side structures 11. Decks and Hatch Openings 12. Effective breadth 13. Iterative determination of scantlings (POSEIDON)	
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht	

ourse L0413: Fundamentals of Ship Structural Design		
Тур	Recitation Section (small)	
Hrs/wk		
СР	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: Fundam	ourse L0410: Fundamentals of Ship Structural Analysis		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Sören Ehlers		
Language	DE		
Cycle	WiSe		
Content	Contents: 1. Introduction 2. Finite element method (f.e. method) by the example of trussworks 3. Force methods for frameworks 4. F.e. method for frameworks 5. Shear and torsion in thin-walled beams 6. Beams subjected to longitudinal forces		
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente		

urse 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	

a				
Courses				
Title Computational Fluid Dynam	ics I (10235)	Typ Lecture	Hrs/wk 2	СР 3
Computational Fluid Dynam		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Requirements				
Recommended Previous Knowledge	 Mathematical Methods for Fundamentals of Different 	Engineers ial/integral calculus and series expansions		
Educational Objectives	After taking part successfully, stu	dents have reached the following learning	results	
Professional Competence				
competence	The students are able to list the	basic numerics of partial differential equat	ons.	
Knowledge				
		ppropriate numerical integration in space y can code computational algorithms in a		
Skills				
Personal Competence	The students are survive at work.			
Social Competence	The students can arrive at work i	esults in groups and document them.		
	The students can independently	analyse approaches to solving specific pro	blems.	
Autonomy				
Workload in Hours	Independent Study Time 124, St	udy Time in Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and scale	2h			
	General Engineering Science (Ge	erman program, 7 semester): Specialisatio	on Energy ar	nd Enviromen
	Engineering: Compulsory	German program, 7 semester): Specia	isation Nav	al Architectu
	Compulsory			
	General Engineering Science (G Focus Energy Systems: Elective (erman program, 7 semester): Specialisat Compulsory	on Mechanio	cal Engineerir
		erman program, 7 semester): Specialisat	on Mechanio	cal Engineerir
		erman program, 7 semester): Specialisati	on Energy ar	nd Enviromen
	Engineering: Elective Compulsor	y erman program, 7 semester): Specialisat	on Mechanic	cal Engineerir
	Focus Theoretical Mechanical En	gineering: Elective Compulsory		
Following Curricula		plementary Course Core Studies: Elective C nglish program, 7 semester): Specialisatio		nd Enviromen
	Engineering: Elective Compulsor			
	Engineering: Compulsory			
	General Engineering Science (E Focus Energy Systems: Elective (nglish program, 7 semester): Specialisat Compulsory	on Mechanio	cal Engineerir
	General Engineering Science	(English program, 7 semester): Specia	isation Nav	al Architectu
	Compulsory			
	Mechanical Engineering: Speciali	sation Energy Systems: Elective Compulso	ry	

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

ourse 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

Module M0640: S	tochastics and Ship Dynamics			
Courses				
Title Ship Dynamics (L0352) Ship Dynamics (L1620) Statistics and Stochastic Pro (L0364)	ocesses in Naval Architecure and Ocean Engineering	Typ Lecture Recitation Section (small) Lecture	Hrs/wk 2 1 2	CP 3 1 3
Module Pesnonsible	Prof. Moustafa Abdel-Maksoud			
-				
Admission Requirements	None			
Recommended Previous Knowledge	Linear algebra analysis complex numbers			
Educational Objectives	After taking part successfully, students have reach	ed the following learning	results	
Professional Competence				pplication goa
Knowledge	 The students are able to give an overview over rudder design. The students can name computation methods waves. 		-	
Skills	 The students can come up with the equations of can use and linearise them. The students are able to determine hydrodyna meaning. The students can explain how a rudder works a occur. 	mic coefficients and they	can explai	n their physic
	 The students can mathematically describe waves The students can explain the mathematically des determine them. 		tions in wav	es and they ca
Personal Competence				
. sistina competence	- The students can arrive at work results in groups	and document them.		
Social Competence				
Autonomy	- The students can assess their own strengthes a this basis.	nd weaknesses and the d	efine furthe	r work steps o
Workload in Hours	Independent Study Time 140, Study Time in Lectu	re 70		
Credit points	7			
Course achievement	None			
	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula		, 7 semester): Specialis		

ourse L0352: Ship Dy	urse L0352: Ship Dynamics		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Moustafa Abdel-Maksoud		
Language	DE		
Cycle	SoSe		
Content	Maneuverability of ships Equations of motion Hydrodynamic forces and moments Linear equations and their solutions Full-scale trials for evaluating the maneuvering performance Regulations for maneuverability Rudder Seakeeping Representation of harmonic processes Motions of a rigid ship in regular waves Flow forces on ship cross sections Strip method Consequences induced by ship motion in regular waves Behavior of ships in a stationary sea state Long-term distribution of seaway influences		
Literature	 Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory Hamburg University of Technology, 2014 Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House Jordan Hill, Oxford, United Kingdom, 2000 Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, Canada,1978 Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993 Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Berlir Heidelberg, Deutschland, 1992 Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, United Kingdom, 1990 Handbuch der Werften, Deutschland, 1986 Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom, 2001 Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllability. Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989 Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004 Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998 		

ourse L1620: Ship Dyr	rse L1620: Ship Dynamics	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Moustafa Abdel-Maksoud	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Volker Müller
Language	DE
Cycle	WiSe
Content	 descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function
Literature	 V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001 H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition, Joh Wiley & Sons, Inc., New York, NY, 2009 ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011 F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability and Statistics, Springer, 2005 Springer Handbook of Engineering Statistics, H. Pham (Hrsg.), Springer, 2006 A. Klenke, Wahrscheinlichkeitstheorie, Springer, 2013

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			
Admission Requirements	None		
	Good knowledge in Mathemathics I-III and Mechanics I-III.		
Recommended Previous Knowledge	It is recommended that the students are familiar with typical design relevant drawings, e.g. Body Plan GA- Plan, Tank Plan etc.		
Educational Objectives	After taking part successfully, students have reached the following learning	results	
Professional Competence			
Knowledge	The lecture enables the student to carry out all necessary theoretical calculations for ship design or scientific level. The lecture is basic requirement for all following lectures in the subjects shipo desi and safety of ships.		
	and safety of ships.		
Skills	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking.	ship has su	
Personal Competence	The student is able to carry out hydrostatic calculations to ensure that the s He is able to design hull forms that are safe against capsizing or sinking.	ship has su	
Personal Competence	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking.	ship has su	
Personal Competence	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking. The student gets access to hydrostatical problems.	ship has su	
Personal Competence Social Competence Autonomy	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking. The student gets access to hydrostatical problems.	ship has su	
Personal Competence Social Competence Autonomy	The student is able to carry out hydrostatic calculations to ensure that the s He is able to design hull forms that are safe against capsizing or sinking. The student gets access to hydrostatical problems. Independent Study Time 96, Study Time in Lecture 84	ship has su	
Personal Competence Social Competence Autonomy Workload in Hours	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking. The student gets access to hydrostatical problems. Independent Study Time 96, Study Time in Lecture 84 6	ship has su	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking. The student gets access to hydrostatical problems. Independent Study Time 96, Study Time in Lecture 84 6 None Written exam	ship has su	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement	The student is able to carry out hydrostatic calculations to ensure that the He is able to design hull forms that are safe against capsizing or sinking. The student gets access to hydrostatical problems. Independent Study Time 96, Study Time in Lecture 84 6 None Written exam	ship has su	

Typ Lecture Hrs/wk 2 CP 3 Workload in Hours Independent Study Time 62, Study Time	
СР 3	
Workload in Hours Independent Study Time 62. Study Time	
	in Lecture 28
Lecturer Prof. Stefan Krüger	
Language DE	
Cycle SoSe	
1. Numerical Integration, Diffrentation, Ir	nterpolation
- Trapezoidal Rule, Simpson, Tschebysc	cheff, graphical Integration Methods
- Determination of Areas, 1st and 2nd o	order Moments
- Numerical Diffrentation, Spline Interpo	olation
2. Buyoancy	
- Principle of Archimedes	
- Equlibrium Floating Condition	
- Equlibrium Computations	
- Hydrostatic Tables and Sounding Tab	bles

- Trim Tables
- 3. Stability at large heeling angles
- Stability Equation
- Cross Curves of Stability and Righting Levers
- Numerical and Graphical Determination of Cross Curves
- Heeling Moments of Free Surfaces, Water on Deck, Water Ingress
- Heeling Moments of Different Type
- Balance of Heeling and Righting Moments acc. to BV 1030
- Intact Stability Code (General Critaria)
- 4. Linearization of Stability Problems
- Linearization of Restoring Forces and Moments
- Correlation between Metacentric Height and Righting Lever at small heeling angles
- Computation of Path of Metacentric Height for Modern Hull Forms
- Correlation between Righting Lever and Path of Metacentric Height
- Hydrostatic Stiffness Matrix
- Definition of MCT
- Computation of Equilibrum Floating Conditions from Hydrostatic Tables
- Effect of Free Surfaces on Initial GM
- Roll Motions at Small Roll Angles
- 6. Stability in Waves
 - Roll Motions at Large Amplitudes
 - Pure Loss of Stability on the Wave Crest
- Principle of Parametric Excitation
- Principle of Direct Wave Moments

Content - Grim's Equivalent Wave Concept

- 6 Longitudinal Strength
- Longitudinal Mass Distribution, Shear Forces, Bending Moments
- Longitudinal Strength in Stability Booklet
- 7. Deadweight Survey and Inclining Experiment
- Deplacement Computations from Draft mark Readings
- Weights to go on /come from board
- Inclining Experiment with Heeling Moments from Weights and Heeling Tanks
- Residual Sounding Volumes
- Determination of COG from Metacentric height and from Cross Curves
- Roll Decay Test
- 8. Launching and Docking
 - Launching Plan, Arrangement of Launching Blocks
 - Rigid Body Launching: Tilting, Dumping, Equation of Techel
 - Computation of Launching Event
 - Bottom Pressure and Longitudinal Strength
 - Linear- Elastic Effects
 - Transversal Stability on Slipway and in Dock
- 9. Grounding
 - Loss of Buoynacy when Grounded

	- Pointwise Grounding
	- Ship Grounds on Keel
	10. Introduction into Damage Stability Problems
	- Added Mass Method
	- Loss of Buoyant Volume Method
	- Simple Equilibrium Computations
	- Intermediate Stages of Flooding (Addes Mass Method), Cross- and Downflooding
	- Water Ingress Through Openings
	11. Special Problems (optional and agreed upon)
	- e.g. Heavy Lift Operations
	- e.g. Jacking of Jackup Vessels
	- e.g. Sinking After Water Ingress
-	1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig
Literature	2. Henschke Schiffstechnisches Handbuch, Band 1
	3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

Course L1261: Hydrost	urse L1261: Hydrostatics	
Тур	Typ 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	

urse L1452: Body Pla	an
Тур	Project Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of : - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration fo several heeling angles.
Literature	 Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepag abrufbar.

Courses				
Title Resistance and Propulsion (I Resistance and Propulsion (I		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 3 3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	 Mechanics Fluid Dynamics for Naval Architects Hydrostratics 			
Educational Objectives	After taking part successfully, students have	reached the following learning	results	
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant different resistance phenomena and their pra and empirical prediction methods are subje resistances are dealt with. The course include ships. This hold also for propulsion and hullefi Focus is how hull forms can be optimized for topics are dealt with:	ctical applications to hullform ect of the course. Furthermore as model test techniques and t ficiency elements, mainly thrus	design as we e, environme heir applicat t deduction	ell as numerica ental additiona tion to full scale and wake. Mair
	 Stillwater/added resistance, Wave resistance methods, friction laws, laminar/turbulent flow Appendage Design and resistance, Froude ' wake, model scaling laws, resistance tests, fr tests, full scale speed power predictions, ar EEDI, speed trials, contractual matters concert 	r separation, Hull form design f s resistance law,form factor ee running propeller tests and dditional resistances (wind, sto	or redcude f method, th propeller ba eering, curr	flow separation rust deduction sics, propulsion
Skills	The student shall learn to design competitive numreical techniques and to evaluate these h will enable the student to clearl determine a influences.	nulls by several progosis method	ods. Furterm	ore, the course
Personal Competence				
Social Competence	The student learns to prepare technical mat suvervision team.	ters in such a way that he ca	n compte w	ith his building
Autonomy	The student learns to prepare technical mat suvervision team.	ters in such a way that he ca	n compte w	ith his building
Workload in Hours	Independent Study Time 124, Study Time in I	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German pro Compulsory General Engineering Science (English pro Compulsory			

Course L1265: Resistance and Propulsion	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	
Literature	

Course L1266: Resistar	urse L1266: Resistance and Propulsion	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
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	

Courses				
Fitle Fundamentals of Materials S	Science I (L1085)	Typ Lecture	Hrs/wk 2	CP 2
	Science II (Advanced Ceramic Materials, Polymers and	Lecture	2	2
Composites) (L0506) Physical and Chemical Basic	cs of Materials Science (L1095)	Lecture	2	2
Module Responsible	Prof. löra Weißmüller			
Admission Requirements				
Recommended Previous Knowledge		atics		
ducational Objectives	After taking part successfully, students have reacl	hed the following	learning results	
Professional Competence	The students have acquired a fundamental kno	wledge on metal	ls, ceramics and pol	
Knowledge	describe this knowledge comprehensively. Fundamental knowledge here means specifically the issue of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanic properties. The students know about the key aspects of characterization methods for materials and ca identify relevant approaches for characterizing specific properties. They are able to trace materia 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 lar of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, a stiffness, chemical properties such as corrosion resistance, and to phase transformations such solidification, precipitation, or melting. The students can explain the relation between processi conditions and the materials microstructure, and they can account for the impact of microstructure the material's behavior.			
Personal Competence				
Social Competence				
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German program,	•	ecialisation Mechanic	
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program.	•		cal Engineerin
	General Engineering Science (German program,	7 semester): Spe n, 7 semester): n, 7 semester):	cialisation Energy ar Specialisation Nava	cal Engineerin nd Enviroment al Architectur
Assignment for the Following Curricula	General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	7 semester): Spe m, 7 semester): m, 7 semester): ompulsory : Compulsory lification: Compuls 7 semester): Spec	cialisation Energy ar Specialisation Nava Specialisation Nava Sory cialisation Energy an	cal Engineerin nd Enviroment al Architectur al Architectur nd Enviroment
Assignment for the Following Curricula	General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory Data Science: Specialisation Materials Science: Co Digital Mechanical Engineering: Core qualifications Energy and Environmental Engineering: Core qual General Engineering Science (English program, Engineering: Compulsory General Engineering Science (English program,	7 semester): Spe m, 7 semester): m, 7 semester): ompulsory : Compulsory lification: Compuls 7 semester): Spe 7 semester): Spe n, 7 semester):	cialisation Energy an Specialisation Nava Specialisation Nava cialisation Energy an ecialisation Mechanic Specialisation Nava	cal Engineerin ad Enviroment al Architectur al Architectur ad Enviroment cal Engineerin al Architectur

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

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

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

Course L1095: Physical	and Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Müller
Language	DE
Cycle	WiSe
Content	 Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	 Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", der Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer

Courses				
Courses		T	Live (sul-	CD
Title Ship Design (L1262)		Typ Lecture	Hrs/wk 2	СР 3
Ship Design (L1264)		Recitation Section (large)		3
Module Responsible	Prof. Stefan Krüger			
Admission	None			
Requirements				
Recommended Previous Knowledge	 Fluid Dynamics for Naval Architects, Resistance and Propulsion Resistance and Propulsion, Hydrostatics 			
Educational Objectives	After taking part successfully, students have rea	ached the following learning	results	
Professional Competence				
	The lecture starts with an overview about the i Competitive Elements of Ship Designs are the related technical risk are introduced. The most their influence on the competitiveness of a des main parameters on the total performance of a this lecture, the design changes are dealt with learn to model complex systems properly so that The lecture continues with an introduction into	oroughly discussed. Typical important main parameters or sign. The lecture focusses or a ship design and the conse by simple models or formula at the relavent technical cond	bulding cor of a ship are the influen cutive proce le. The stud clusions can	ntracts and the introduced are ce of alternate ess elements. ent shall furth be drawn.
	design phase to a building contract. Further, m relevant information at different levens of gran following topics are adressed:	nethods are introduced to ge	nerate buld	ing specfication
Knowledge	 Structure of a building specification Determination of Light Ship Weight and Deadw Components Design of main section and hull form Design of aftbody lines and manoevering device Design of main propulsion plant Design of subdivision Determination of limiting GMrequ- Curves Scantlings of most improtant structural memb Longitudinal strength Outfitting Components Relevant rules and regulations 	ces		
Skills	The student is made familiar with the basic des the lecture is that the student shall be able comparison fulfilling typical contract requirem with the basic design methods to determine the with respect to fulfillment procedures of the co Design" the relevant methods to determine a treated.	to carry out a concept de ents within the Marine Envi e fundamantal technical cha ontract values. Based on the	sign based ronment. Th racteristics e lecture "Pi	on a vessel ne lecture dea of a ship desig rinciples of Sh
Personal Competence				
Social Competence	The students learns to prepare technical mat customer against his competitors.	ters in such a way the he	can persua	de his potanti
Autonomy	The students learns to prepare technical mat customer against his competitors.	ters in such a way the he	can persuad	de his potanti
Workload in Hours	Independent Study Time 124, Study Time in Leo	cture 56		
Credit points				
Course achievement	None			
Examination				
Examination duration and scale	180 min			
Assignment for the Following Curricula	General Engineering Science (German progr Compulsory General Engineering Science (English progr Compulsory Naval Architecture: Core qualification: Compulso	am, 7 semester): Speciali		

Course L1262: Ship Des	ourse L1262: Ship Design	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1264: Ship Design	
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	
Literature	

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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 Introduction into Process Engineering/Bioprocess Engineering (L0829) Fundamentals of material engineering (L0830)			Typ Lecture Lecture	Hrs/wk 2 2	CP 1 2
Module Responsible	Prof. Michael Schlüte	er			
Admission Requirements	None				
Recommended Previous Knowledge	none				
Educational Objectives	After taking part suc	cessfully, students ha	ave reached the following l	earning results	
Professional Competence Knowledge	After passing this module the students have the ability to: • give an overview of the most important fields on process and bioprocess engineering, • explain some working methods for different fields in process engineering.				
Skills	 After passing this module the students should have the ability to: list and outline the most important fields of process engineering, name the most important working approaches or methods of the different fields of process engineering, read and prepare an engineering drawing, explain the most important technologies for wastewater and exhaust air treatment scheme typical chemical and biotechnological processes independently with the aid of pointers. 				
Personal Competence	The students are ab	le to			
Social Competence		lts in groups and doc ppriate feedback and	ument them, handle feedback on their o	wn performance cor	nstructively.
	The students are able to estimate their progress of learning by themselves and to deliberate their lac of knowledge in Process Engineering and Bioprocess Engineering.				
Workload in Hours	Independent Study	Гіте 34, Study Time i	n Lecture 56		
Credit points	3				
Course achievement	CompulsorBonus	Form Written elaboration	Description		
Examination					
Examination duration and scale	90 min				

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

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

Course L0830: Fundame	Course L0830: Fundamentals of material engineering		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Marko Hoffmann		
Language	DE		
Cycle	WiSe		
Content	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials 		
Literature	 Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W.,Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012. 		

Module M0937: B	hysical Chemistry			
	nysical chemistry			
Courses				
Title		Тур	Hrs/wk	СР
Physical Chemistry (L0833) Physical Chemistry (L0835)		Lecture Practical Course	2 2	2 1
Module Responsible	Dr. Worper Pauer		-	-
Admission Bequirements				
Requirements	None			
Recommended Previous Knowledge	Contents of the previous modules inorganic o	hemistry, physics for engi	neers and mathe	matics I-III.
Educational Objectives	After taking part successfully, students have	reached the following lear	ning results	
Professional Competence				
competence	The students are able,			
	-to repeat the basic concepts of physical che	mistry		
Knowledge		-		
	-to describe and summarize the underlying concepts of mass-, heat- and momentum transfer.			
	- to interpret phase diagrams and affiliate kir	ietic rate laws.		
	The students are able to			
	- conduct (fundamental) thermodynamical, electrochemical and kinetic calculations.			
Skills	s - 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, co	nduct and document exp	eriments accord	ing to scientifi
Easial Compotence	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 knowld	5	,	
	Students are able to apply their knowldege discretely to plan, prepare and conduct experiments.			
	Independent Study Time 34, Study Time in Le	ecture 56		
Credit points				
Course achievement	CompulsorBonus Form Subject theoretica	Description		
	Yes None practical work			
Examination	Written exam			
Examination duration and scale	180 min			
	General Engineering Science (German pro	gram, 7 semester): Spec	cialisation Proce	ss Engineering
Assignment for the	Elective Compulsory Bioprocess Engineering: Core gualification: E	lective Compulsory		
	General Engineering Science (English pro		ialisation Proce	ss Engineerin <u>c</u>
	Elective Compulsory Process Engineering: Core qualification: Elect	ive Compulsory		
	Frocess Engineering: Core qualification: Elect	ive compuisory		

Course L0833: Physical	Chemistry
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alf Mews
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	 P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013 P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008 G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012 R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993 U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011

Course L0	335: Physical Chemistry
Тур	Practical Course
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Alf Mews
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

Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L032	21)		Lecture	3	4
Computer Engineering (L032	24)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
	Basic knowledge in ele	ectrical engineering			
Previous Knowledge					
	After taking part succe	essfully, students hav	e reached the following learning) results	
Professional Competence					
	 This module deals with the foundations of the functionality of computing systems. It covers the from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware syn combinational networks Sequential logic: Flip-flops, automata, systematic hardware design 			topics:	
Kilowieuge	 Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelinin Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poi connections, busses 				
	internal structure and highly specific and in components. They are	dents perceive computer systems from the architect's perspective, i.e., they identify the structure and the physical composition of computer systems. The students can analyze, he specific and individual computers can be built based on a collection of few and simp ents. They are able to distinguish between and to explain the different abstraction layers computing systems - from gates and circuits up to complete processors.			
	After successful completion of the module, the students are able to judge the interdependenci 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 abstracti layers from the assembly language down to gates. This way, they will be enabled to evaluate t impact that these low abstraction levels have on an entire system's performance and to propo feasible options.				
Personal Competence					
Social Competence	Students are able to se	olve similar problems	alone or in a group and to pres	ent the result	s accordingly
			ge from specific literature and		
Workload in Hours	Independent Study Tin	ne 124, Study Time ir	n Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus	Form	Description		
	Yes 10 %	Excercises			
Examination Examination duration	Written exam				
and scale	90 minutes, contents o	of course and labs			
	General Engineering	Science (German p	program, 7 semester): Specia	lisation Com	puter Sciend
	Compulsory General Engineering S	Science (German pro	gram, 7 semester): Specialisat	ion Bioproce	ss Engineerir
	Compulsory				
	Compulsory	science (German p	orogram, 7 semester): Specia	isation Nava	a Architectu
	General Engineering	Science (German	program, 7 semester): Speci	alisation Civ	il Engineerir
		Science (German pr	ogram, 7 semester): Specialis	ation Electric	al Engineerir
	Compulsory General Engineering S	Science (German pro	gram, 7 semester): Specialisat	ion Biomedic	al Engineerir
	Compulsory				U U
	Engineering: Compulse General Engineering	ory	gram, 7 semester): Specialisati rogram, 7 semester): Speciali		
	Compulsory				

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

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

Course L0324: Compute	urse 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 Process			Typ Lecture Recitation Section (larc	Hrs/wk 2 ge) 2	CP 4 2
Module Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	 Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration 				
Educational Objectives	After taking part succe	essfully, students ha	ve reached the following learn	ing results	
Professional Competence					
Knowledge	 explain the difference between different types of flow give an overview for different applications of the Reynolds Transport-Theorem in process engineering explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundar conditions 				
Skills	 The students are able to describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitativ solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering 				
Personal Competence					
Social Competence	 The students are capable to gather information from subject related, professional publications and relate the information to the context of the lecture and able to work together on subject related tasks in small groups. They are able to present the results effectively in English (e.g. during small group exercises) are able to work out solutions for exercises by themselves, to discuss the solutions orally and the present the results. 				
	The students are able	to			
Autonomy	 search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. 				
Workload in Hours	Independent Study Tin	ne 124, Study Time	in Lecture 56		
Credit points	6				
Course achievement	CompulsorBonus Yes 5 %	Form Midterm	Description		
	Written exam				
Examination duration and scale					
Assignment for the Following Curricula	Compulsory General Engineering S Compulsory General Engineering S Engineering: Compulso Bioprocess Engineering Energy and Environme General Engineering Compulsory General Engineering S Compulsory	Science (German pr Science (German pr Dry g: Core qualification ental Engineering: Co Science (English pr Science (English pro Science (English pro	orogram, 7 semester): Speci ogram, 7 semester): Speciali ogram, 7 semester): Specialis : Compulsory ore qualification: Compulsory rogram, 7 semester): Specialis ogram, 7 semester): Specialis	sation Bioproce ation Energy a alisation Proce sation Bioproce	ess Engineering nd Enviroment ess Engineering ess Engineering

Process Engineering: Core qualification: Compulsory

Тур	Lecture
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	 fluid properties hydrostatic overall balances - theory of streamline overall balances - conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematisch Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömunger Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoder Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgäng dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2013

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

Courses				
Title Phase Equilibria Thermodyn Phase Equilibria Thermodyn Phase Equilibria Thermodyn	amics (L0140)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1 1	CP 2 2 2
		Recitation Section (large)	T	Z
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermody	namics I and II		
Educational Objectives	After taking part successfully, students have	e reached the following learning	results	
Professional Competence				
Knowledge	 Starting from the very basics of ther describe thermodynamic equilibria. They learn how state variables are in quantitatively describe these propert Moreover, the students learn how phenomena may occur if differer Furthermore the fundamentals of rea For different phase equilibria, sever shown and the necessary knowledge 	fluenced by the mixing of compo ies. hase equilibria can be described it phases (vapor, liquid, solio ction equilibria are taught. al examples relevant for differ	ounds and le I mathemati d) coexist ent kinds o	earn concepts cally and whi in equilibriu f processes a
Skills	 Applying their knowledge, the studdetermination of the equilibrium state. The students know models which can equilibrium state and they are able to For specific applications, they are properties of compounds as well as m Beside pure compound properties to mixtures. The students know how to visualize p the occurring phenomena. Based on their knowledge, the stude the basis for many separation and read the basis for many separation and the basis for many separation	e and know how to simplify these n be used to determine the prop o solve the resulting mathematic e able to self-reliantly find n nodel parameters in literature so the students are capable of de phase equilibria graphically and ents are able to understand fund	e equations perties of th al relations. ecessary p urces. escribing th they know l damental co	meaningfully. e system in t hysico-chemic e properties how to interpr
Personal Competence				
Social Competence	The students are able to work in small gro them oraly to the tutors and other students	oups, to solve the correspondin	g problems	and to prese
Autonomy	 The students are able to find neces judge their quality. During the semester the students a exercises. Based on this knowledge to 	are able to check their learnin	g progress	continuously
Workload in Hours	Independent Study Time 124 Study Time in	Lecture 56		
Credit points	Independent Study Time 124, Study Time in	Lecture 50		
Course achievement				
Examination				
	120 minutes; theoretical questions and calc	ulations		
Assignment for the	General Engineering Science (German pr Compulsory General Engineering Science (German pro Compulsory Bioprocess Engineering: Core qualification: (General Engineering Science (English pro Compulsory	ogram, 7 semester): Specialis gram, 7 semester): Specialisati Compulsory	on Bioproce	ss Engineerir

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

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

Course L0140: Phase Ed	quilibria Thermodynamics	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	SoSe	
Content	 Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure 	
Literature	 Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O ´Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. 	

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

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C	ompulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Biomechanics: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Energy Systems: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Aircraft Systems Engineering: Compulsory
	eneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	ocus Materials in Engineering Sciences: Compulsory
	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
	omputational Science and Engineering: Core qualification: Compulsory
	lechatronics: Core qualification: Compulsory
Te	echnomathematics: Specialisation III. Engineering Science: Elective Compulsory

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

Courses					
Fitle Bioprocess Engineering - Fui Bioprocess Engineering- Fun			Typ Lecture Recitation Section (large)		CP 3 1
Bioprocess Engineering - Fui		se (L0843)	Practical Course	2	2
Module Responsible	Prof. Andreas Liese				
Admission Requirements	None				
Recommended Previous Knowledge	none, module "organic	chemistry", module "fund	amentals for process engine	eering"	
ç	After taking part succe	ssfully, students have read	hed the following learning	results	
Professional Competence					
Knowledge	Students are able to describe the basic concepts of bioprocess engineering. They are able to classif different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry and rheology can be named and mass transport processed in bioreactors can be explained. The students are capable to explain fundamental bioprocess management, sterilization technology and downstream processing in detail. After successful completion of this module, students should be able to				
Skills	 describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters predict qualitatively the influence of energy generation, regeneration of redox equivalents are growth inhibition on the fermentation process analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic aerobic as well as microaerobic) to compare them as well as to apply them to curre biotechnical problem propose solutions to complicated biotechnological problems and to deduce the correspondir models to explore new knowledge resources and to apply the newly gained contents identify scientific problems with concrete industrial use and to formulate solutions. to document and discuss their procedures as well as results in a scientific manner 				
Social Competence	teams to enhance the		rould be able to debate to their own opinions and ents.	•	
	After completion of this module participants will be able to solve a technical problem in a tear independently by organizing their workflow and to present their results in a plenum.				
Workload in Hours	Independent Study Tim	ne 96, Study Time in Lectu	re 84		
Credit points	6				
	Compulsor B onus	Form	Description		
Course achievement	Yes 5 %	Subject theoretical a practical work	and		
Examination					
Examination duration and scale	90 min				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Process Engine Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engine Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engine Compulsory				ss Engineeri ss Engineeri ss Engineeri npulsory ory Compulsory

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

Course L0842: Bioproce	urse L0842: Bioprocess Engineering- Fundamentals				
Тур	Recitation Section (large)				
Hrs/wk					
СР					
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28				
	Prof. Andreas Liese, Prof. An-Ping Zeng				
Language					
Cycle	SoSe 1. Introduction (Prof. Liese, Prof. Zeng)				
Content	 Enzymatic kinetics (Prof. Liese) Stoichiometry I + II (Prof. Liese) Microbial Kinetics I+II (Prof. Zeng) Rheology (Prof. Liese) Mass transfer in bioprocess (Prof. Zeng) Continuous culture (Chemostat) (Prof. Zeng) Sterilisation (Prof. Zeng) Downstream processing (Prof. Liese) Repetition (Reserve) (Prof. Liese, Prof. Zeng) 				
Literature	siehe Vorlesung				

Course L0843: Bioproce	ess Engineering - Fundamental Practical Course
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Contont	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 M0618: R	enewables and Energy System	ns			
Courses					
Title Power Industry (L0316) Energy Systems and Energy Renewable Energy (L0313) Renewable Energy (L1434)	r Industry (L0315)	Typ Lecture Lecture Lecture Recitation Section (small)	Hrs/wk 1 2 2	CP 1 2 2 1	
	Prof. Martin Kaltschmitt	Reclador Sector (Smail)	-	-	
Admission Requirements	None				
Recommended Previous Knowledge	none				
	 After taking part successfully, students hav	e reached the following learning	results		
Professional Competence					
Knowledge	With completion of this module, the students can provide an overview of characteristics of energy systems and their economic efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, power distribution and power trading wih regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss them Furthermore, the students can explain the environmental benefits from the use of such systems.				
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 condition Therefore, they can choose the necessary subject-specific calculation rules, also for not standardize solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field renewable energies orally and to put them them into the right context.				
Personal Competence					
Social Competence	The students are able to analyze suitable technical alternatives and to assess them with technical economical and ecological criteria under sustainability aspects. This allows them to make an effective contribuition to a more sustainable power supply.				
Autonomy	Students can independently exploit sources , acquire the particular knowledge about the subject are and transform it to new questions.				
	Independent Study Time 96, Study Time in	Lecture 84			
Credit points					
Course achievement					
Examination Examination duration and scale	3 hours written exam				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviroment Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Elective Compulsory Energy and Environmental Engineering: Core qualification: 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 Mechanical Engineerin Focus Energy Systems: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineerin Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineerin Elective Compulsory Process Engineering: Core qualification: Compulsory				

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

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

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

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

Courses						
Title			Тур	Hrs/wk	СР	
Chemical Reaction Engineering (Fundamentals) (L0204)			Lecture	2	2	
Chemical Reaction Engineer Experimental Course Chemi	•		Recitation Section (la Practical Course	irge) 2 2	2 2	
-			Flactical Course	Z	Z	
Module Responsible						
Requirements	None					
Recommended Previous Knowledge			matics I-III, physical chemistry ineers.	y, technical therr	modynamics I	
ducational Objectives	After taking part succe	essfully, students ha	we reached the following lear	ning results		
Professional Competence						
	out differences betwe to outline parts of isot	The students are able to explain basic concepts of chemical reaction engineering. They are able to poir 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.				
	After successful comp	letion of the module	e, students are able to:			
	 apply different comp 	utational methods t	o dimension isothermal and r	non-isothermal id	eal reactors,	
Skills	- determine and compute stable operation points for these reactors ,					
	- conduct experiments on a lab-scale pilot plants and document these according to scientific gu					
Personal Competence						
Social Competence	After successful completition of the lab-course the students have a strong ability to organize themselfe in small groups to solve issues in chemical reaction engineering. The students can discuss their subje- related knowledge among each other and with their teachers.					
Autonomy	The students are able to obtain further information and assess their relevance autonomously. Student can apply their knowldege discretely to plan, prepare and conduct experiments.					
Workload in Hours	Independent Study Tir					
Credit points						
•	CompulsorBonus	Form	Description			
Course achievement	Yes None	Subject theore	•			
Examination	Written exam	•				
Examination duration and scale	120 min					
	General Engineering	Science (German	program, 7 semester): Spe	cialisation Proce	ss Engineeri	
	Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Compulsory					
	Bioprocess Engineering: Core qualification: Compulsory					
3	Bioprocess Engineering: Core qualification: Compulsory					
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering					
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory					
	Process Engineering: (Core qualification: C	ompulsory			

Course L0204: Chemica	l Reaction Engineering (Fundamentals)		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Raimund Horn		
Language	DE		
Cycle	WiSe		
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)		

	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key
	species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element- species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)
Content	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler- number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, molebalance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	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
1	

ανΤ	Recitation Section (large)
Hrs/wk	
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 concentrat (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volu chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, m concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reac reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in statio and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, species, matrix of stoichiometric coefficients, linear dependent and independent reactions, elem species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, rela between stoichiometry and kinetics, calculating the extent of reaction from mole number change complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical read engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in pr- first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entr Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, v Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibri calculations in multiple reaction systems, Lagrange Multipliers)
Content	Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reacti elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, of change of species mole number, Arrhenius-equation, activation energy and pre-exponential fa for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköl number, differential and integral method of kinetic analysis, laboratory reactors for kin measurements, half life, kinetics of complex reactions, parallel reactions, reversible reacti sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanis quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analy integration of first order differential equations - integrating factor, numerical integration of com kinetics)
	Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reakt discontinuous, half continuous and continuous reactors, single phase - biphasic- and multipl reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiak 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 reach integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, re balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - flow reactor, design of plug flow reactors for reactions with volume change and complex reacti- mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continue stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, m balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactor. Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic tempera rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design o adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfe convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, mul stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothe 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 Cher Wiley-VCH

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

Course L0221: Experimental Course Chemical Engineering (Fundamentals)			
Тур	Practical Course		
Hrs/wk			
СР			
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 M1275: E	nvironmental Te	echnology			
Courses					
Title Practical Exercise Environme Environmental Technologie			Typ Practical Course Lecture	Hrs/wk 1 2	CP 1 2
	Prof. Martin Kaltschmitt	t		_	_
	None				
Recommended Previous Knowledge	Fundamentals of inorga	anic/organic chemistry a	and biology		
Educational Objectives	After taking part succes	ssfully, students have re	eached the following lear	ning results	
Professional Competence					
Knowledge	technology. They are a	ble to describe the beha	tudents obtain profour aviour of chemicals in the . They can explain tern	e environment. Si	tudents can give
Skills	Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.				
Personal Competence					
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation.				
Autonomy		Students can independently exploit sources about of the subject, acquire the particular knowledge and tranfer it to new problems.			
Workload in Hours	Independent Study Tim	e 48, Study Time in Leo	ture 42		
Credit points	3				
Course achievement	Compulsor₿onus Yes None	Form Subject theoretical practical work	Description and		
Examination	Written exam				
Examination duration and scale	1 hour				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess 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 Process Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Process Engineering: Core qualification: Elective Compulsory				

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

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

Courses				
Title Introduction to Control Syste Introduction to Control Syste		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
		Rectation Section (Smail)	-	-
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems ir	n time and frequency domain, Lapla	ce transform	
Educational Objectives	After taking part successfully, students h	nave reached the following learning	results	
Professional Competence				
Knowledge	 Students can represent dynamic particular explain properties of firm They can explain the dynamics of of frequency response and root lo They can explain the Nyquist stab They can explain the role of the p They can explain the way a PII response They can explain issues arising implemented digitally 	st and second order systems simple control loops and interpret cus wility criterion and the stability marg hase margin in analysis and synthe D controller affects a control loop	dynamic pro ins derived f sis of control in terms o	perties in tern rom it. loops f its frequend
Skills	 Students can transform models of linear dynamic systems from time to frequency domain an vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequence response techniques They can calculate discrete-time approximations of controllers designed in continuous-time an use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks 			
Personal Competence				
Social Competence	Students can work in small groups to join	ntly solve technical problems, and e	experimental	ly validate the
	controller designs Students can obtain information from experiment guides) and use it when solv	provided sources (lecture notes		
Autonomy	They can assess their knowledge in wee	kly on-line tests and thereby contro	l their learnii	ng progress.
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	· ·			
Course achievement				
Examination				
Examination duration and scale	120 min			
	General Engineering Science (German pr Bioprocess Engineering: Core qualificatio Computer Science: Specialisation Compu Data Science: Core qualification: Elective Electrical Engineering: Core qualification Energy and Environmental Engineering: General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English	on: Compulsory utational Mathematics: Elective Com e Compulsory : Compulsory Core qualification: Compulsory program, 7 semester): Specialisa n program, 7 semester): Specia	npulsory tion Electric Ilisation Civ	al Engineerin il Engineerin

	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
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	Focus Aircraft Systems Engineering: Compulsory
i enering curreata	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	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
	recess Engineering, core qualification: compulsory

Course L0654: Introduc	tion to Control Systems			
	Lecture			
Hrs/wk				
CP				
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 Vyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Frequency response interpretation of PID control 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	 Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 			

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

Courses					
Title			Тур	Hrs/wk	СР
Practical Course Measureme			Practical Course	2	2
Measurement Technology (I Physical Fundamentals of M		(2269)	Lecture Lecture	2 2	2 2
Module Responsible		,		_	_
Admission					
Requirements	None				
Recommended Previous Knowledge	Technical interest, logical skills, integral- and differential calculus, basic physical concepts such as temperature, mass, velocity, etc				
Educational Objectives	After taking part succe	ssfully, students have	reached the following learn	ing results	
Professional Competence					
			(theory of motion), rotatic f hydrodynamics, temperat		
Knowledge	Metrology: SI units, me principles, temperati measurement. Usage c	ure measurement,	urement uncertainty, basics pressure measurement,		
		ement and mass tra	calorimetry, image data a Insfer, capacitive measure aphy		
Skills	Literature research, categorisation of thematical topics, analysis of an experimental test stand preparation of test protocol, first programming with Matlab, use of relevant laboratory measuremen technology, preparation of a test protocol, execution of calculations.				
Personal Competence					
Social Competence	Arrangement and division of work in practical training and learning groups, assessment of own level of knowledge, work on the experimental stand in groups, consultation with persons responsible for teaching, presentation of the preparation of the experiment, tolerance of frustration				
Autonomy	Time management of the workload, independent development of the thematic basics, person responsibility for the provision of protective equipment and work clothing, practice of presentation front of a group, active participation in the lectures, formulation of enquiries/detailed questions busing clicker.				
Workload in Hours	Independent Study Tim	ie 96, Study Time in L	ecture 84		
Credit points	6				
Course achievement	Compulsor B onus Yes 5 %	Form Attestation	Description Testate für Messted	hnikpraktikum	
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula					

Course L2270: Practica	l Course Measurement Technology		
Тур	Practical Course		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Michael Schlüter		
Language	DE		
Cycle	WiSe		
Content	In the Practical Course in Measurement Technology the theory from the lectures "Physical Fundamentals of Measurement Technology" and "Measurement Technology" will be applied in practice. In small groups students learn how to handle different measurement techniques from industry and research. During the practical course, a wide range of different measurement methods will be taught, including the use of HLPC columns for qualitative mass analysis, the determination of mass transfer coefficients using optical oxygen sensors or the evaluation of image data to obtain process parameters. The practical course also teaches how measurement data are statistically evaluated and experiments are correctly documented.		
Literature	Hug, H.: Instrumentelle Analytik. Theorie und Praxis. Verlag Europa-Lehrmittel, Haan-Gruiten, 2015. Kamke, W.: Der Umgang mit experimentellen Daten, insbesondere Fehleranalyse, im physikalischen Anfänger-Praktikum. Eine elementare Einführung. W. Kamke, Kirchzarten [Keltenring 197], 2010. Strohrmann, G.: Messtechnik im Chemiebetrieb. Einführung in das Messen verfahrenstechnischer Größen. Oldenbourg, München, 2004.		

Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Alexandra von Kameke
Language	DE
Cycle	WiSe
Content	Basic introduction to measurement technology for process engineers. Includes error calculation measurement units, calibration, measurement data analysis, measurement techniques and sensor Particular attention is paid to the measurement of temperature, pressure, flow and level. The lectu provides insights into the latest developments in sensor technology in measurement technology an process engineering.
Literature	 Fraden, Jacob (2016): Handbook of Modern Sensors. Physics, Designs, and Applications. 5th ed. 201 Cham, New York: Springer. Online verfügbar unter http://search.ebscohost.com/login.aspo direct=true&scope=site&db=nlebk&AN=1081958. Hering, Ekbert; Schönfelder, Gert (2018): Sensoren in Wissenschaft und Technik. Funktionsweise ur Einsatzgebiete. 2. Aufl. 2018. Online verfügbar unter http://dx.doi.org/10.1007/978-3-658-12562-2. Strohrmann, Günther (2004): Messtechnik im Chemiebetrieb. Einführung in das Messo verfahrenstechnischer Größen. 10., durchges. Aufl. München: Oldenbourg. Tränkler, Hans-Rolf; Reindl, Leonhard M. (2014): Sensortechnik. Handbuch für Praxis und Wissenschaf 2., völlig neu bearb. Aufl. Berlin: Springer Vieweg (VDI-Buch). Online verfügbar unter http://dx.doi.org/10.1007/978-3-642-29942-1. Webster, John G.; Eren, Halit B. (2014): Measurement, Instrumentation, and Sensors Handbook, Secor Edition. Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement. 2nd ed. Hoboke Taylor and Francis. Online verfügbar unter http://gbv.eblib.com/patron/FullRecord.aspx?p=1407945.

Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Schroer
Language	DE
Cycle	WiSe
Content	
Literature	

Courses Title Thermal Separation Process Thermal Separation Process Thermal Separation Process	es (L0119) es (L0141)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 2 1	CP 2 2 1
Separation Processes (L115		Practical Course	1	1
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge		cs III		
Educational Objectives Professional Competence		reached the following learning	results	
Knowledge	 The students can distinguish and dedistillation, extraction, and adsorption The students develop an understanding process, the estimation of the energy and the selection of separation system They have good knowledge of designing 	ing for the course of concent demand of a process, the pos s	ration durir ssibilities of	ng a separati energy savir
Skills	 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 The students can use different graphical methods for the designing of a separation process define the amount of theoretical stages required They can select and design a basic type of thermal separation process for a given case based the advantages and disadvantages of the process The students are capable to obtain independently the needed material properties fr appropriate sources (diagrams and tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the experimental lab work. The students are able to discuss the theoretical background and the content of the experime work with the teachers in colloquium. 			
Personal Competence				
Social Competence	 The students can work technical assign in the tutorial The students are able to carry out pra division of labor between them. They scientifically in a report. 	ictical lab work in small group:	s and organ	ize a functior
Autonomy	 The students are capable to obtain the and assess their quality The students can proof the state of th this way control their learning process 			-
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement	None			
Examination				
Examination duration	120 minutes; theoretical questions and calcul			

Process Engineering: Core gualification: Compulsory

Course L0118: Thermal	Separation Processes		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	rof. Irina Smirnova		
Language)E		
Cycle	WiSe		
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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 		

Тур	Recitation Section (small)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	 Introduction in the thermal process engineering and to the main features of separatio processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students. 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. 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 		

Түр	Recitation Section (large)		
Hrs/wk			
CP	1		
Workload in Hours	- Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle			
Content	 Introduction in the thermal process engineering and to the main features of separatic processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 17985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th experimental of McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie 		

Typ	Practical Course	
Hrs/wk		
CP		
_		
	Prof. Irina Smirnova	
Language		
	WiSe	
Content	 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. 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. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Selection of separation processes Selection of separation processes 	
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 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. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th experimental of Comparison of Comp	

Heat and Mass Transfer (L1868) Recitation Module Responsible Admission Requirements Prof. Irina Smirnova Admission Requirements None Basic knowledge Basic knowledge: Technical Thermodynamics Previous Knowledge Basic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the follow professional Competence None The students are capable of explaining qualitative and procedural apparatus (e. g. heat exchanger, chemical They are capable of distinguish and characterize difficity to explain the physica describe mass transfer qualitative and quantitative by They are able to depict the analogy between heat- ar linked processes in detail. Knowledge • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. • The students are able to solve specific heat transfer p temperature alteration in fluids) and to calculate the c eapparatus. • They are capable to distinguish between diffusion, conv They can use this knowledge for the description and di rectification column). • In this context, the students are capable to choose a mass exchanger for a specific application consideri respectively. • In estudents are capable to connect their knowledge other courses (In particular the courses thermodynami engineering) to solve concrete technical problems. Personal Competence • The students are capable to work on subject-specific results orally in a reasonable mann			
Heat and Mass Transfer (L0101) Hexture Recutation Module Responsible reat and Mass Transfer (L0108) Prof. Irina Smirnova Addmission Requirements None Basic knowledge: Technical Thermodynamics Previous Knowledge Basic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the follow professional Competence <i>Knowledge</i> The students are capable of distinguish and characterize difficance and quantitative by the act conduction, heat transfer and thermal rac the students have the ability to explain the physica describe mass transfer qualitative and quantitative by The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. They are capable to solve specific heat transfer p temperature alteration in fluids) and to calculate the c apparatus Skills Skills Skills The students are capable to solve specific heat transfer tespectively. In this context, the students are capable to choose a mass exchanger for a specific application consider respectively. In addition, they can calculate both, steady-state and apparatus. The students are capable to work on subject-specific results orally in a reasonable manner to tutors and oth respectively. In addition, they can calculate both, steady-state and apparatus. The students are capable to work on subject-specific results orally in a reasonable manner to tutors and oth respectively. The students are capable to find and evaluate necessary i . The			
teat and Mass Transfer (L186) Recitation Module Responsible Requirements Prof. Irina Smirnova Admission Requirements None Basic knowledge: Technical Thermodynamics Basic knowledge: Technical Thermodynamics Previous Knowledge After taking part successfully, students have reached the folion of the students are capable of explaining qualitative and particular the ability to explain the physica describe mass transfer qualitative and thermal ray in the ability to explain the physica describe mass transfer qualitative and quantitative by Knowledge • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. • The students are able to solve specific heat transfer patients have the students are the students are the students are the students are the student can exe apapature alteration in fluids) and to calculate the conservely. • The students are able to solve specific heat transfer patients physica calculate the conservely. • They are capable to solve specific heat transfer patients is knowledge for the description and directification column). • They are able to distinguish between diffusion, converting varianties, the students are capable to choose a mass exchanger for a specific application consider respectively. • The students are capable to connect their knowledge for the escription and directification column). • The students are capable to work on subject-specific resputerses (In particular the course thermodynamic respectively. • In addition, they can calculate both, steady-state		Hrs/wk 2	CP 2
Module Responsible Requirements Prof. Irina Smirnova Recommended Previous Knowledge Basic knowledge: Technical Thermodynamics Basic knowledge Basic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the foll Professional Competence • The students are capable of explaining qualitative and procedural appartus (e.g. heat exchanger, chemical They are capable of distinguish and characterize dif namely heat conduction, heat transfer and thermal rac The students have the ability to explain the physica describe mass transfer qualitative and quantitative by they are able to depic the analogy between heat- at linked processes in detail. • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. • They are capable to solve specific heat transfer pu temperature alteration in fluids) and to calculate the c Using dimensionless quantities, the students can exe apparatus. • They are able to distinguish between diffusion, conv They are able to distinguish between diffusion, convert They are able to distinguish between diffusion, convert They are able to distinguish between diffusion, convert ther courses (in particular the courses thermodynam engineering) to solve concrete technical problems. Personal Competence • The students are capable to work on	Section (small)	1	2
Admission Requirements None Recommended Previous Knowledge Basic knowledge: Technical Thermodynamics Educational Objectives After taking part successfully, students have reached the folic Professional Competence • The students are capable of explaining qualitative and procedural apparatus (e.g., heat exchanger, chemical 1 They are capable of distinguish and characterize dif namely heat conduction, heat transfer and thermal rat • The students have the ability to explain the physica describe mass transfer qualitative and quantitative by • They are able to depict the analogy between heat- ar linked processes in detail. • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. • The students are able to solve specific heat transfer p temperature alteration in fluids) and to calculate the c • Using dimensionless quantities, the students can exe apparatus. • They are able to distinguish between diffusion, conv They can use this knowledge for the description and dr respectively. • In this context, the students are capable to choose a mass exchanger for a specific application consider respectively. • In addition, they can calculate both, steady-state and apparatus. • The students are capable to connect their knowledge other courses (In particular the courses thermodynam engineering) to solve concrete technical problems. Personal Competence • The students are capable to work on subject-specific results orally in a reasonable manner to tutors and oth continuously (clicker-system, exam-like assignments) learning processes. <th>n Section (large)</th> <td>1</td> <td>2</td>	n Section (large)	1	2
Recommended Previous Knowledge Basic knowledge: Technical Thermodynamics Basic knowledge Basic knowledge: Technical Thermodynamics Siducational Objectives After taking part successfully, students have reached the folion procedural apparatus (e.g. heat exchanger, chemical They are capable of distinguish and characterize difficance) Knowledge • The students are capable of distinguish and characterize difficance) Knowledge • The students are bable to explain the physica describe mass transfer qualitative and quantitative by they are able to depict the analogy between heat- ar linked processes in detail. • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. • The students are able to solve specific heat transfer p temperature alteration in fluids) and to calculate the c. • Using dimensionless quantities, the students are capable to choose a mass exchanger for a specific application consideri respectively. • In addition, they can calculate both, steady-state and apparatus. • The students are capable to connect their knowledge other courses (In particular the courses thermodynam engineering) to solve concrete technical problems. Personal Competence • The students are capable to work on subject-specific results orally in a reasonable manner to tutors and other courses (In particular the courses thermodynam engineering) to solve concrete technical problems. Personal Competence • The			
Recommended Previous Knowledge Basic knowledge: Technical Thermodynamics iducational Objectives After taking part successfully, students have reached the folit Professional Competence if the students are capable of explaining qualitative and procedural apparatus (e.g. heat exchanger, chemical They are capable of distinguish and characterize difinamely heat conduction, heat transfer and thermal rad manely heat conduction, heat transfer and thermal rad the students have the ability to explain the physica describe mass transfer qualitative and quantitative by They are able to depic the analogy between heat- at linked processes in detail. inked processes in detail. • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. They are capable to solve specific heat transfer p temperature alteration in fluids) and to calculate the c. Using dimensionless quantities, the students can exe apparatus. They are able to distinguish between diffusion, convi they can use this knowledge for the description and di respectively. In addition, they can calculate both, steady-state and apparatus. The students are capable to connect their knowledge other courses (in particular the courses thermodynam engineering) to solve concrete technical problems. Personal Competence Autonomy The students are capable to work on subject-specific results orally in a reasonable manner to tutors and other continuously (clicker-system, exam-like assignments) learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56 <			
Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the follogeneration Competence • The students are capable of explaining qualitative and procedural apparatus (e.g., heat exchanger, chemical They are capable of distinguish and characterize diff namely heat conduction, heat transfer and thermal ration describe mass transfer qualitative and quantitative by • The students have the ability to explain the physica describe mass transfer qualitative and quantitative by • They are able to depict the analogy between heat- ar linked processes in detail. • The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. • The students are able to solve specific heat transfer p temperature alteration in fluids) and to calculate the c Using dimensionless quantities, the students can exe apparatus. • They are able to distinguish between diffusion, conv They can use this knowledge for the description and d rectification column). • In this context, the students are capable to choose a mass exchanger for a specific application consideri respectively. • In addition, they can calculate both, steady-state and apparatus. • The students are capable to consect their knowledge other courses (in particular the curves thermodynam engineering) to solve concrete technical problems. Personal Competence Autonomy • The students are capable to work on subject-specific results orally in a reasonable manner to tutors and oth results orally in a reasonable manner to tutors and oth results orally in a reasonable manner to tutors and oth results orally in a reasonable manner to tutors and oth results			
Professional Competence The students are capable of explaining qualitative and procedural apparatus (e. g. heat exchanger, chemical They are capable of distinguish and characterize diffi- namely heat conduction, heat transfer and thermal ra- tionation of the students have the ability to explain the physica describe mass transfer qualitative and quantitative by The students are able to depict the analogy between heat- at linked processes in detail. The students are capable to solve specific heat transfer preservively. They are capable to solve specific heat transfer preservively. They are capable to solve specific heat transfer premerature alteration in fluids) and to calculate the ce apparatus. They are capable to distinguish between diffusion, convict they are table to distinguish between diffusion, convict they are able to distinguish between diffusion, convict they can use this knowledge for the description and durectification column). In this context, the students are capable to choose a mass exchanger for a specific application consideri respectively. In addition, they can calculate both, steady-state and apparatus. The students are capable to connect their knowledge other courses (In particular the courses thermodynam engineering) to solve concrete technical problems. Personal Competence The students are able to find and evaluate necessary i The students are able to find and evaluate necessary i The students are able to find and evaluate necessary i The students are able to find and evaluate necessary i The students are able to find and evaluate necessary i			
Competence The students are capable of explaining qualitative and procedural apparatus (e. g. heat exchanger, chemical They are capable of distinguish and characterize dift namely heat conduction, heat transfer and thermal race describe mass transfer qualitative and qualitative by They are capable to depict the analogy between heat- and linked processes in detail. <i>Knowledge</i> The students are able to set reasonable system bou using the gained knowledge and to balance the respectively. They are capable to solve specific heat transfer patterne alteration in fluids) and to calculate the c Using dimensionless quantities, the students can exe apparatus. They are able to distinguish between diffusion, convint They can use this knowledge for the description and directification column). In this context, the students are capable to choose a mass exchanger for a specific application considering respectively. In addition, they can calculate both, steady-state and apparatus. The students are capable to connect their knowledge other courses (In particular the courses thermodynam engineering) to solve concrete technical problems. The students are able to find and evaluate necessary i They are able to prove their level of knowledge during continuously (clicker-system, exam-like assignments) learning processes. 	lowing learning	results	
workload in Hours Independent Study Time 124, Study Time in Lecture 56 workload in Hours Independent Study Time 124, Study Time in Lecture 56			
Skills using the gained knowledge and to balance the respectively. • They are capable to solve specific heat transfer p temperature alteration in fluids) and to calculate the c • Using dimensionless quantities, the students can exe apparatus. • They are able to distinguish between diffusion, conv. They can use this knowledge for the description and durectification column). • In this context, the students are capable to choose a mass exchanger for a specific application considerin respectively. • In addition, they can calculate both, steady-state and apparatus. • The students are capable to connect their knowledge other courses (In particular the courses thermodyname engineering) to solve concrete technical problems. Personal Competence Social Competence • The students are capable to find and evaluate necessary i • The students are able to find and evaluate necessary i • They are able to prove their level of knowledge during continuously (clicker-system, exam-like assignments) learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56	reactors). fferent kinds of diation. al basis for mas vusing suitable	heat trans ss transfer mass transf	fer mechanisr in detail and er theories.
Social Competence The students are capable to work on subject-specific results orally in a reasonable manner to tutors and oth The students are able to find and evaluate necessary i They are able to prove their level of knowledge during continuously (clicker-system, exam-like assignments) learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56	 They are capable to solve specific heat transfer problems (e.g. heated chemical reactor temperature alteration in fluids) and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer They can use this knowledge for the description and design of apparatus (e.g. extraction column). In this context, the students are capable to choose and design fundamental types of heat an mass exchanger for a specific application considering their advantages and disadvantage respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedur apparatus. The students are capable to connect their knowledge obtained in this course with knowlegde other courses (In particular the courses thermodynamics, fluid mechanics and chemical proce 		
Social Competence results orally in a reasonable manner to tutors and oth • The students are able to find and evaluate necessary i • They are able to prove their level of knowledge during continuously (clicker-system, exam-like assignments) learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56			
Autonomy • They are able to prove their level of knowledge during continuously (clicker-system, exam-like assignments) learning processes. Workload in Hours Independent Study Time 124, Study Time in Lecture 56		teams and	l to present t
	 The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicker-system, exam-like assignments) and on this basis they can control thei learning processes. 		
Course achievement None			
Examination Written exam			
Examination duration 120 minutes; theoretical questions and calculations			

	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 Energy and Enviromental
	Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
Assignment for the	Energy and Environmental Engineering: Core qualification: Compulsory
Following Curricula	General Engineering Science (English program, 7 semester): Specialisation Bioprocess 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
	Technomathematics: Specialisation III. Engineering Science: 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	 Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions 	
Literature	 H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas 	

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

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

Module M0891: Ir	nformatics for Process Engi	neers		
Courses				
Title		Тур	Hrs/wk	СР
Informatics for Process Engi Informatics for Process Engi		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.			
Educational Objectives	After taking part successfully, students I	have reached the following learning	results	
Professional Competence		· · · · · ·		
-	Students can describe procedural and o	bject-oriented concepts.		
Knowledge				
Skills	Students are capable of object-oriented programming in the programing language Java and of solvir mathematic questions by using Matlab. Students are capable of developing concepts (simple algorithms) to solve technical questions.			
Personal Competence Social Competence	Students are able to work out solutions	together in small groups.		
Autonomy	Students are able to assess acquired skills by applying it in practice.			
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points				
Course achievement	None			
Examination				
Examination duration and scale	90 min			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromenta Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromenta Engineering Science (English program, 7 semester): Specialisation Process Engineering Elective Compulsory Process Engineering: Core qualification: Compulsory			

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

Course L0837: Informa	tics for Process Engineers		
Тур	Recitation Section (small)		
Hrs/wk			
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: Numerio	and Matlah
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	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Module M0670: P	article Techno	logy and Solid	s Process Engineerii	ng	
Courses					
Title			Тур	Hrs/wk	СР
Particle Technology I (L0434 Particle Technology I (L0435			Lecture Recitation Section (sm	2 all) 1	3 1
Particle Technology I (L0440			Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich				
Admission Requirements	None				
Recommended Previous Knowledge	keine				
Educational Objectives	After taking part suc	cessfully, students ha	ve reached the following learr	ning results	
Professional Competence					
	After successful com	pletion of the module	students are able to		
Knowledge			nit-operations of solids proces butions and to discuss their b		
Skills	 Students are able to choose and design apparatuses and processes for solids processing according to the desire solids properties of the product asses solids with respect to their behavior in solids processing steps document their work scientifically. 				
Personal Competence					
Social Competence		e to discuss scientific technical-scientific is	topics orally with other stude sues in a group.	nts or scientific	personal and
Autonomy	Students are able to	analyze and solve qu	estions regarding solid particle	es independentl	у.
Workload in Hours	Independent Study T	ime 110, Study Time	in Lecture 70		
Credit points					
	CompulsorBonus	Form	Description		
Course achievement	• •	Written elaboratio	sechs Berichte (nr	o Versuch ein	Bericht) à 5-1
Examination	Written exam				
Examination duration and scale					
Assignment for the Following Curricula	Compulsory General Engineering Compulsory General Engineering Engineering: Compul Bioprocess Engineeri Energy and Environm General Engineering Compulsory General Engineering Engineering: Compul General Engineering Compulsory	Science (German pr Science (German pro sory ng: Core qualification nental Engineering: Co Science (English pro Science (English pro sory	pre qualification: Compulsory ogram, 7 semester): Speciali gram, 7 semester): Specialis rogram, 7 semester): Spec	isation Bioproce ation Energy ar sation Bioproce ation Energy ar	ess Engineerin nd Enviroment ess Engineerin nd Enviroment

Course L0434: Particle	Technology I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport
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.

ourse L0435: Particle Technology I	
Recitation Section (small)	
1	
1	
Independent Study Time 16, Study Time in Lecture 14	
Prof. Stefan Heinrich	
DE	
SoSe	
See interlocking course	
See interlocking course	

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

Courses				
Title Management Tutorial (L088 Introduction to Managemen		Typ Recitation Section (large) Lecture	Hrs/wk 2 3	CP 3 3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business			
Educational Objectives	After taking part successfully, students have rea	ched the following learning	results	
Professional Competence	After taking this module, students know the im	portant basics of many diffe	erent areas i	in Business ar
Knowledge	 Management, from Planning and Organisation to Controlling. In particular they are able to explain the differences between Econo Management and to name important defir explain the most important aspects of an aspects of entreprneurial projects describe and explain basic business funct chain management, organization and hum innovation management and marketing explain the relevance of planning and comultiple objectives and uncertainty, ar Finance state basics from accounting and costing and	omics and Management a hitions from the field of Man d goals in Management an tions as production, procure han ressource management decision making in Busines d explain some basic m and selected controlling me	and the su agement d name the ement and s c, information s, esp. in s ethods from thods.	b-disciplines most importa ourcing, supp n managemen ituations und mathematic
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 analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 			
Personal Competence				
Social Competence	 Students are able to work successfully in a team of students to apply their knowledge from the lecture report on the project to communicate appropriately and to cooperate respectfully with their fellow 		roject and w	vrite a cohere
Autonomy	Students are able towork in a team and to organize the team tto write a report on their project.	hemselves		
	Independent Study Time 110, Study Time in Lect	ture 70		
Credit points				
Course achievement	None Subject theoretical and practical work			
Examination duration	several written exams during the semester			
	General Engineering Science (German program, Civil- and Environmental Engineering: Core quali Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulsor Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compu Energy and Environmental Engineering: Core qualification: Compu	fication: Compulsory tion Civil Engineering: Electi tion Water and Environmeni tion Traffic and Mobility: Ele pulsory ry	ve Compuls : Elective Co	ory ompulsory

1	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil 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
	General Engineering Science (English program, 7 semester): Specialisation Computer Science:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
	Focus Biomechanics: Compulsory
Assignment for the	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Following Curricula	
5	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 Naval Architecture:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
	Compulsory
	Computational Science and Engineering: Core qualification: Compulsory
	Logistics and Mobility: Core qualification: Compulsory
	Mechanical Engineering: Core qualification: Compulsory
	Mechatronics: Core qualification: Compulsory
	Orientierungsstudium: Core qualification: Elective Compulsory
1	Naval Architecture: Core qualification: Compulsory
	Technomathematics: Core qualification: Compulsory
ı	Process Engineering: Core qualification: Compulsory

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

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

Module M0539: P	rocess and Plan	t Engineering l			
Courses					
Title Process and Plant Engineeri Process and Plant Engineeri Process and Plant Engineeri	ng I (L0096)		Typ Lecture Recitation Section (lar Recitation Section (sm		CP 2 2 2
Module Responsible	Prof. Mirko Skiborowsk	i			
Admission Requirements	None				
Recommended Previous Knowledge	unit operation of thermal an dmechanical separation processes chemical reactor eingineering				
Educational Objectives	After taking part succe	ssfully, students have	reached the following learr	ning results	
Professional Competence					
	students can:				
	classify and formulate	blobal balance equation	ns of chemical processes		
Knowledge	specify linear compone	ent equations of compl	ex chemical processes		
	explain linear regression and data reconcilliation problems				
	explain pfd-diagrams				
	students are capable of				
	- - formulation of mass and energy balance equations and estimation of product streams				
	- estimation of component streams of chemical plants using linear component balance models				
Skills					
	- conduction of process synthesis				
	- economic evaluation of processes and the estimation of production costs				
	- economic evaluation	of processes and the e	stimation of production co	STS	
Personal Competence					
Social Competence Autonomy					
	Independent Study Tim	ne 124, Study Time in	ecture 56		
Credit points	6				
Course achievement	CompulsorBonusYes10 %	Form Subject theoretica practical work	Description and		
Examination	Written exam				
Examination duration and scale	1 20 1000 100010000 10000	s and books			
	Compulsory General Engineering S Compulsory General Engineering S Engineering: Elective C Bioprocess Engineering S General Engineering S Compulsory General Engineering S Engineering: Elective C	cience (German prog compulsory compulsory core qualification: C cience (English progr cience (English progr compulsory Science (English progr	am, 7 semester): Special im, 7 semester): Specialis gram, 7 semester): Spec	isation Bioproce sation Energy ar isation Bioproce sation Energy ar	ess Engineerin nd Enviroment ess Engineerin nd Enviroment

Course L0095: Process and Plant Engineering I		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mirko Skiborowski	

Language	
Cycle	SoSe
Content	 Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression Data reconciliation and data validation Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety S. Cost estimation of production plants Production costs, capital costs, economic evaluation Substance of the synthesis Synthesis of sparatic costs, economic evaluation Substance of the synthesis Synthesis of sparatic costs, economic evaluation Substance of the synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systemsyleps (separation systems (separation systems (separation sys
Literature	 S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001 G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg D. Hairston, Chemical Engineering, October 2001, S. 31-37 J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002 J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511 K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824 S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169 J. Mittelstraß, ChemIngTech. 62(1990)Nr. 13, S.169 J. Mittelstraß, ChemIngTech. 62(1990)Nr. 13, S.169 J. Mittelstraß, ChemIngTech. 61(1989), Nr. 2, S. 104-112 G. Kaibel, ChemIng. Technol
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	H.J. Lang, Chem. Eng. 54(10),117, 1947 H.J. Lang, Chem. Eng. 55(6), 112, 1948
	11110000 (00000 1000 10/(0) 110 10/(0)

F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process	Irse L0096: Process and Plant Engineering I		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Mirko Skiborowski, Dr. Thomas Waluga		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1214: Process and Plant Engineering I		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Mirko Skiborowski, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title	(10000)	Тур	Hrs/wk	СР
Environmental Assessment Environmental Assessment	. ,	Lecture Recitation Section (small)	2 1	2 1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Bequirements	None			
Requirements		nistry and biology		
Previous Knowledge		nistry and biology		
	After taking part successfully, students	have reached the following learning	results	
Professional Competence				
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are completed to the methodological diversity and are completed			
Skills	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.			
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical 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 sensitivity and consciousness towards these subjects are raised and which helps to raise their awareness of the future social responsibilities in their role as engineers.			
Autonomy	The students learn to research, process carry out independent scientific work. T and are able to judge results of other pu	hey can solve an environmental pro		
Workload in Hours	Independent Study Time 48, Study Time	in Lecture 12		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Elective Compulsory General Engineering Science (Germar Elective Compulsory Bioprocess Engineering: Core qualificati Energy and Environmental Engineering: General Engineering Science (English Elective Compulsory General Engineering Science (English Engineering: Compulsory General Engineering Science (English Elective Compulsory General Engineering Science (English Elective Compulsory Process Engineering: Core qualification:	program, 7 semester): Specialisation program, 7 semester): Specialisation on: Elective Compulsory Core qualification: Compulsory program, 7 semester): Specialisation program, 7 semester): Specialisation program, 7 semester): Specialisation	on Bioproce ation Proce on Bioproce n Energy ar	ess Engineeri ss Engineeri ess Engineeri nd Enviromer

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

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

Thesis

Module M-001: Ba	achelor Thesis
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	
Recommended	
Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	 The students can select, outline and, if need be, critically discuss the most important scientifi fundamentals of their course of study (facts, theories, and methods). On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise. The students are able to outline the state of research on a selected issue in their subject area.
Skills	 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. With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions. The students can take up a critical position on the findings of their own research work from a specialized perspective.
Personal Competence	 Both in writing and orally the students can outline a scientific issue for an expert audienc accurately, understandably and in a structured way. The students can deal with issues in an expert discussion and answer them in a manner that i appropriate to the addressees. In doing so they can uphold their own assessments any viewpoints convincingly.
Autonomy	 The students are capable of structuring an extensive work process in terms of time and or dealing with an issue within a specified time frame. The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem. The students can apply the essential techniques of scientific work to research of their own.
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0
Credit points	
Course achievement	None
Examination	
Examination duration and scale	According to General Regulations
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Thesis: Compulsory Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Data Science: Thesis: Compulsory Digital Mechanical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory Engineering Science: Thesis: Compulsory General Engineering Science (English program, 7 semester): Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechatronics: Thesis: Compulsory

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