

Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (German program, 7 semester)

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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

- · 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 Responsible	Dagmar Richter
-	None
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The Non-technical Academic Programms (NTA)
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fu Self-reliance, self-management, collaboration and professional and personnel management competences. The departme implements these training objectives in its teaching architecture , in its teaching and learning arrangements , in teach areas and by means of teaching offerings in which students can qualify by opting for specific competences and a compete level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechn complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechn academic programms follow the specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual development competences. It also provides orientation knowledge in the form of "profiles"
	The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation study these subjects in one or two specific semesters during the course of studies.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dea with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberat encouraged in specific courses.
	Fields of Teaching
	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migral studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semes 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a ge oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging go oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. Th differences are reflected in the practical examples used, in content topics that refer to different professional application conte and in the higher scientific and theoretical level of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leaders functions of Bachelor's and Master's graduates in their future working 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 the disciplines represented in learning area, different specialist disciplines relate to their own discipline and differentiate it as well as make connections, sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representa in the specialized sciences are subject to individual and socio-cultural interpretation and historicity, Can communicate in a foreign language in a manner appropriate to the subject.
Skills	Professional Competence (Skills)
54115	
	In selected sub-areas students can
	 apply basic methods of the said scientific disciplines, auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned special 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 technical relationship to the subject.

Social Competence	Personal Competences (Social Skills)
	Students will be able
	 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.
Autonomy	Personal Competences (Self-reliance) Students are able in selected areas
	 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
Credit points	6

Courses

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

Module M0743: Electi	rical Engineerir	ng I: Direct C	urrent Networks	and Electromagnet	ic Fields	
Courses						
Title				Тур	Hrs/wk	СР
Electrical Engineering I: Direct Curr				Lecture	3	5
Electrical Engineering I: Direct Curr	rent Networks and Electr	romagnetic Fields (L0	0676)	Recitation Section (small)	2	1
Module Responsible	Prof. Manfred Kasper					
Admission Requirements	None					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part succ	cessfully, students	have reached the follow	ing learning results		
Professional Competence						
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study T	ime 110, Study Tin	ne in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	No 10 %	Excercises				
Examination	Written exam					
Examination duration and	zweistündig					
scale						
Assignment for the	General Engineering	Science (German p	program): Core Qualificat	tion: Compulsory		
Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory					
	Electrical Engineering: Core Qualification: Compulsory					
	Computational Science and Engineering: Core Qualification: Compulsory					
	Computational Science and Engineering: Core Qualification: Compulsory					
	Mechatronics: Core Q	Qualification: Comp	ulsory			

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

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

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Module M0889: Mech	anics I (Static	s)				
Courses						
Title				Тур	Hrs/wk	СР
Mechanics I (Statics) (L1001)				Lecture	2	3
Mechanics I (Statics) (L1002)				Recitation Section (small)	2	2
Mechanics I (Statics) (L1003)				Recitation Section (large)	1	1
Module Responsible	Prof. Robert Seifried	k				
Admission Requirements	None					
Recommended Previous	Solid school knowle	dge in mathematics a	and physics.			
Knowledge						
Educational Objectives	After taking part suc	ccessfully, students h	nave reached the followir	ng learning results		
Professional Competence						
Knowledge	The students can					
	 describe the 	axiomatic procedure	used in mechanical cont	exts.		
		rtant steps in model				
		nical knowledge in st	-			
	• present tech	filear knowledge in so	ereostatics.			
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 statical methods to engineering problems; estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets. 					
	 estimate tre 	reach and boundarie	is of statical methods and	a extend them to be applica	ble to wider probl	em sets.
Personal Competence						
Social Competence	The students can we	ork in groups and sup	oport each other to over	come difficulties.		
Autonomy	Students are canabl	le of determining the	ir own strengths and we	aknesses and to organize the	eir time and learn	ing based on thos
		<u> </u>	· · · · · · · · ·	5		,
Workload in Hours	Independent Study	Time 110, Study Tim	e in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	No 20 %	Midterm	wird nur im v	ViSe angeboten		
Examination	Written exam					
Examination duration and	90 min					
scale						
-		-	rogram): Core Qualificati			
Following Curricula				e Qualification: Compulsory		
			ore Qualification: Compul	sory		
	Mechanical Enginee	ering: Core Qualificati	on: Compulsory			
	Mechatronics: Core	Qualification: Compu	ilsory			
	Naval Architocturo:	Core Qualification: C	ompulsory			

Course L1001: Mechanics I (Statics)
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	 Tasks in Mechanics Modelling and model elements Vector calculus for forces and torques Forces and equilibrium in space Constraints and reactions, characterization of constraint systems Planar and spatial truss structures Internal forces and moments for beams and frames Center of mass, volumn, area and line Computation of center of mass by intergals, joint bodies Friction (sliding and sticking) Friction of ropes
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).
	D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

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

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

Module M0850: Math	ematics I				
Courses					
		T	Hara taula	65	
Title		Тур	Hrs/wk	СР	
Analysis I (L1010)		Lecture	2	2	
Analysis I (L1012)		Recitation Section (small)	1	1	
Analysis I (L1013)		Recitation Section (large)	1	1	
Linear Algebra I (L0912)		Lecture	2	2	
Linear Algebra I (L0913)		Recitation Section (small)	1	1	
		Recitation Section (large)	1	1	
Linear Algebra I (L0914)		Recitation Section (large)	1	1	
Module Responsible					
Admission Requirements					
Recommended Previous	School mathematics				
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge					
-	 Students can name the basic conception 	ots in analysis and linear algebra. They are ab	le to explain the	em using appropria	
	examples.				
	 Students can discuss logical connection 	ons between these concepts. They are capable	of illustrating th	lese connections w	
	the help of examples.				
	 They know proof strategies and can re 	produce them.			
Skills					
Skiis	 Students can model problems in analy 	sis and linear algebra with the help of the conc	epts studied in t	his course. Moreov	
	they are capable of solving them by a	oplying established methods.			
	they are capable of solving them by applying established methods.Students are able to discover and verify further logical connections between the concepts studied in the course.				
	 For a given problem, the students ca 	an develop and execute a suitable approach, a	nd are able to c	ritically evaluate t	
	results.				
Personal Competence					
Social Competence					
	 Students are able to work together in 	teams. They are capable to use mathematics as	a common langu	age.	
	 In doing so, they can communicate ne 	w concepts according to the needs of their coop	perating partners	. Moreover, they c	
	design examples to check and deepen	the understanding of their peers.			
		and anaciotationing of their peersi			
Autonomy					
	 Students are capable of checking their 	ir understanding of complex concepts on their o	wn. They can sp	ecity open questio	
	precisely and know where to get help	in solving them.			
	 Students have developed sufficient p 	ersistence to be able to work for longer period	ls in a goal-orier	ited manner on ha	
	problems.	3 1 1 1	-		
	problems.				
Workload in Hours		Lecture 112			
Credit points Course achievement					
Examination	Written exam				
		1)			
	60 min (Analysis I) + 60 min (Linear Algebra	1)			
scale					
Assignment for the	General Engineering Science (German progra	am): Core Qualification: Compulsory			
Following Curricula	General Engineering Science (German progra	am, 7 semester): Core Qualification: Compulsory			
	Civil- and Environmental Engineering: Core Q	ualification: Compulsory			
	Bioprocess Engineering: Core Qualification: C				
	Electrical Engineering: Core Qualification: Co				
	Energy and Environmental Engineering: Core	Qualification: Compulsory			
	Computational Science and Engineering: Cor	e Qualification: Compulsory			
	Computational Science and Engineering: Com				
	Logistics and Mobility: Core Qualification: Cor	mpulsory			
	Mechanical Engineering: Core Qualification: 0	Compulsory			
Mechatronics: Core Qualification: Compulsory					
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Comp	ulsory			

Course L1010: Analysis I					
Тур	Lecture				
Hrs/wk	2				
СР					
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Dozenten des Fachbereiches Mathematik der UHH				
Language	DE				
Cycle	WiSe				
Content	Foundations of differential and integrational calculus of one variable				
	 statements, sets and functions natural and real numbers convergence of sequences and series continuous and differentiable functions mean value theorems Taylor series calculus error analysis fixpoint iteration 				
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 				

Course L1012: Analysis I	Course L1012: Analysis I		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1013: Analysis I	ourse L1013: Analysis I		
Тур	Typ Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	enten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0912: Linear Algebra	al
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner
Language	DE
Cycle	WiSe
Content	 vectors: intuition, rules, inner and cross product, lines and planes systems of linear equations: Gauß elimination, matrix product, inverse matrices, transformations, block matrices, determinants orthogonal projection in Rⁿ, Gram-Schmidt-Orthonormalization
Literature	 T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 G. Strang: Lineare Algebra, Springer-Verlag, 2003 G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013

Course L0913: Linear Algebra	al			
Тур	Recitation Section (small)			
Hrs/wk				
CP	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner			
Language	DE			
Cycle	WiSe			
Content	 vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants 			
Literature	 T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 			

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

Courses				
Title		Тур	Hrs/wk	СР
Physics for Engineers (L0367)		Lecture	2	3
Physics for Engineers (Problem Sol	-	Recitation Section (small)	1	1
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous Knowledge	 Calculus and linear algebra on high : Physics on high school level 	school level		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics.			
Skills	Students can relate physics topics to technical problems. Students can describe physical problems mathematically and solve such problems within the framework of their acquire mathematical expertise.			
Personal Competence Social Competence	Students can jointly solve subject related p problem solving courses.	roblems in groups. They can present their result:	s effectively within	the framework of
Autonomy	the lecture. They can reflect their acquire	formation from the provided references and to a ed level of expertise with the help of lecture a to connect their knowledge with that acquired fro	ccompanying mea	
Workload in Hours	Independent Study Time 78, Study Time in	Lecture 42		
Credit points	4			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	General Engineering Science (German proc	ram, 7 semester): Core Qualification: Compulsor	У	

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

Course L0368: Physics for En	ourse L0368: Physics for Engineers (Problem Solving Course)			
Тур	Recitation Section (small)			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Janfred Eich			
Language				
Cycle	WiSe			
Content	see lecture Physics for Engineers			
Literature	see lecture Physics for Engineers			

Module M0687: Chem	istry			
	-			
Courses				
Title		Тур	Hrs/wk	СР
Chemistry I (L0460)		Lecture	2	2
Chemistry I (L0475)		Recitation Section (large)	1	1
Chemistry II (L0465)		Lecture	2	2
Chemistry II (L0476)	Dr. Daueth eo Daobhair ha ch	Recitation Section (large)	L	1
	Dr. Dorothea Rechtenbach None			
Admission Requirements				
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students h	nave 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, period table, chemical bonds), physical chemistry (aggregate states, separating processes, thermodynamics, kinetics), inorgar chemistry (acid/base, pH-value, salts, solubility, redox, metals) and organic chemistry (aliphatic hydrocarbons, functional group			
	carbonyl compounds, aromates, reaction mechanisms, natural products, synthetic polymers). Furthermore students are ab explain basic chemical terms.			
Skills	After successful completion of this module students are able to describe substance groups and chemical compounds. On this bas they are capable of explaining, choosing and applying specific methods and various reaction mechanisms.			
Personal Competence				
Social Competence	Students are able to take part in discuss contribute to those discussion by their or	sions on chemical issues and problems as a memb wn statements.	er of an interdiscipl	inary team. They c
Autonomy	After successful completion of this mod approaches with arguments. They can al	dule students are able to solve chemical problem lso document their approaches.	is independently by	v defending propos
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German pr	rogram): Core Qualification: Compulsorv		
Following Curricula		rogram, 7 semester): Core Qualification: Compulso	orv	
· ····································	Civil- and Environmental Engineering: Co		,	
	and Environmental Engineering. et			

Course L0460: Chemistry I	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christoph Wutz
Language	DE
Cycle	WiSe
Content	- 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	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure
	- Kickelbick: Chemie für Ingenieure (Pearson)
	- Mortimer: Chemie. Basiswissen der Chemie.
	- Brown, LeMay, Bursten: Chemie. Studieren kompakt.

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

Course L04	165: Chemistry II	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload	Independent Study Time 32, Study Time in Lecture 28	
in Hours		
Lecturer	Dr. Christoph Wutz	
Language	DE	
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 apllications and examples	
Literature	- Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure	
	- Kickelbick: Chemie für Ingenieure (Pearson)	
	- Schmuck: Basisbuch Organische Chemie (Pearson)	

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

Courses				
Title		Тур	Hrs/wk	СР
Programming in C (L0083)		Lecture	1	1
Programming in C (L1488)		Practical Course	1	1
Module Responsible	Prof. Siegfried Rump			
Admission Requirements	None			
Recommended Previous	Elementary PC handling skills			
Knowledge				
	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
Professional Competence				
Knowledge	The students know by heart the basic syntax of C purpose.	programming as well as its meaning, ir	ntent and	
	They know the fundamental components and prin based on C programming and can explain them:	ciples of elementary procedural progra	mming	
	 basic data types (integers, floating point numbe advanced data types (pointers, arrays, strings, or 			
	 operators (arithmetical operations, logical operations) 			
	control flow (choice, loops, jumps, conditional co			
	 functions and macros 			
	 important standard libraries and functions 			
	recursion			
	Iinked lists			
	The students are prepared for continuing program	ming lectures like object oriented prog	ramming in C++.	
Skills	The students know how to use an integrated deve	lopment environment for C programmi	ng on a PC	
	so that they can write, store, compile and execute	e C programs on it.		
	Using their knowledge they are able to read and u	nderstand given C Programs.		
	They can solve simple algorithmic problems on th in C language.	eir own and can model and program th	eir solutions	
	The students are able to solve selected exercises mechanics, electrical engineering or physics with			
Personal Competence				
Social Competence	The students are able to work in small teams to so programming errors and to present their results.	olve given weekly tasks, to identify and	analyze	
	They are able to explain simple phenomena to ea	ch other directly at the PC.		
Autonomy	The students prepare themselves using the given programming exercises on their own.	teaching material and solve the given		
	Additionally, they write small C programs to under	rstand and check addressed issues and	also to	
	gain a certain programming experience.			
	For details beyond the scope of the lecture the stu		ted	
	literature and / or by supplementary own research	1.		
Wenter	Independent Chudu Time 22, Chudu Time i da a	- <u>-</u> - 20		
Workload in Hours	Independent Study Time 32, Study Time in Lectur	e 28		
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and scale	1-2 coding tasks weekly			
Assignment for the	General Engineering Science (German program):	Core Qualification: Compulsory		
Following Curricula	General Engineering Science (German program, 7		sory	
	General Engineering Science (English program): C	ore Qualification: Compulsory		
	General Engineering Science (English program, 7	semester): Core Qualification: Compuls	ory	

Course L0083: Programming	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:
	1. basic data types (integers, floating point numbers, characters, boolean values)
	 advanced data types (meegers, nothing point numbers, end accers, boolean values) advanced data types (pointers, arrays, strings, composed data types, type conversion)
	3. operators (arithmetical operations, logical operations, bit operations)
	4. control flow (choice, loops, jumps, conditional compilation)
	5. functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference",
	storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers)
	6. important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)
	7. 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
	Reading, Mass. [u.a.] : Addison-Wesley, 2007
	Kaiser, Ulrich (Kecher, Christoph.;)
	C/C++: Von den Grundlagen zur professionellen Programmierung
	ISBN: 9783898428392
	Bonn : Galileo Press, 2010
	Wolf, Jürgen
	C von A bis Z : das umfassende Handbuch
	ISBN: 3836214113
	Bonn : Galileo Press, 2009

Course L1488: Programming	ourse L1488: Programming in C	
Тур	Practical Course	
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	See interlocking course	
Literature	See interlocking course	

Title		Тур	Hrs/wk	СР
	g Current Networks and Basic Devices (L0178)	Lecture	3	5
	Current Networks and Basic Devices (L0179)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I			
Knowledge				
	Mathematics I			
	Direct current networks, complex numbers			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
-	Students are able to reproduce and explain fundam	ental theories, principles, and methods	s related to the t	theory of alternation
	currents. They can describe networks of linear eleme			
	an overview of applications for the theory of alterna	ating currents in the area of electrical	engineering. Stud	dents are capable
	explaining the behavior of fundamental passive and a	ctive devices as well as their impact on	simple circuits.	
Skills	Students are capable of calculating parameters with	in simple electrical networks at alterna	ting currents by	means of a compl
	notation for voltages and currents. They can appra	aise the fundamental effects that may	occur within el	ectrical networks
	alternating currents. Students are able to analyze	simple circuits such as oscillating cir	cuits, filter, and	matching netwo
	quantitatively and dimension elements by means of	f a design. They can motivate and jus	tify the fundame	ental elements of
	electrical power supply (transformer, transmission lin	ne, compensation of reactive power, mu	ultiphase system)	and are qualified
	dimension their main features.			
Personal Competence				
Social Competence	Students are able to work together on subject related	tasks in small groups. They are able to	present their resu	ults effectively.
	Students are capable to gather necessary informatio			
	the lecture. They are able to continually reflect their k			
	tests and exercises that are related to the exam. Ba learning process. They are able to draw connections			
	lectures (e.g. Electrical Engineering I, Linear Algebra,		this lecture and	the content of ou
	in the case and any meeting it and any effort			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70		
Credit points				
		scription		
	No 10 % Midterm			
	Written exam			
	90 - 150 minutes			
Examination duration and	190 - 190 Hillinges			
Examination duration and scale				
Examination duration and scale Assignment for the	General Engineering Science (German program): Core			
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German program): Core General Engineering Science (German program, 7 sen	nester): Core Qualification: Compulsory		
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German program): Core General Engineering Science (German program, 7 sen Electrical Engineering: Core Qualification: Compulsory	nester): Core Qualification: Compulsory		
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German program): Core General Engineering Science (German program, 7 sen	nester): Core Qualification: Compulsory , ation: Compulsory		

Course L0178: Electrical Eng	ineering II: Alternating Current Networks and Basic Devices
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	DE
Cycle	SoSe
Content	- General time-dependency of electrical networks
	- Representation and properties of harmonic signals
	- RLC-elements at alternating currents/voltages
	- Complex notation for the representation of RLC-elements
	- Power in electrical networks at alternating currents, compensation of reactive power
	- Frequency response locus (Nyquist plot) and Bode-diagrams
	- Measurement instrumentation for assessing alternating currents
	- Oscillating circuits, filters, electrical transmission lines
	- Transformers, three-phase current, energy converters
	- Simple non-linear and active electrical devices
Literature	- M. Albach, "Elektrotechnik", Pearson Studium (2011)
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
	- R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010)
	- C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009)
	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013)
	- R. Dorf, "The Electrical Engineering Handbook", CRC (2006)

Course L0179: Electrical Eng	ineering II: Alternating Current Networks and Basic Devices
Тур	Recitation Section (small)
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	DE
Cycle	SoSe
Content	- General time-dependency of electrical networks
	- Representation and properties of harmonic signals
	- RLC-elements at alternating currents/voltages
	- Complex notation for the representation of RLC-elements
	- Power in electrical networks at alternating currents, compensation of reactive power
	- Frequency response locus (Nyquist plot) and Bode-diagrams
	- Measurement instrumentation for assessing alternating currents
	- Oscillating circuits, filters, electrical transmission lines
	- Transformers, three-phase current, energy converters
	- Simple non-linear and active electrical devices
Literature	- M. Albach, "Elektrotechnik", Pearson Studium (2011)
	- T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013)
	- R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010)
	- C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009)
	- A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013)
	- R. Dorf, "The Electrical Engineering Handbook", CRC (2006)

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Mechanical Engin	eering Design (L0258)	Lecture	2	3
Fundamentals of Mechanical Engin	eering Design (L0259)	Recitation Section (large)	2	3
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Basic knowledge about mechanics an	d production oppingation		
Knowledge	Internship (Stage Practical)	a production engineering		
	• Internanip (Stuge Friderical)			
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 basic working principles and f 	unctions of machino elements		
		ria, application scenarios and practical exampl	es of basic machi	ne elements indica
	the background of dimensioning calcu		es of busic much	ne cientenes, marca
Skills	After passing the module, students are able	to:		
	accomplish dimensioning calculations	of covered machine elements.		
		dule to new requirements and tasks (problem s	olvina skills).	
	 recognize the content of technical dra 		5 , ,	
	 technically evaluate basic designs. 			
Personal Competence				
Social Competence	Students are able to discuss technica	I information in the lecture supported by activation	ing methods.	
Autonomy	Students are able to independently defined as a second secon	eepen their acquired knowledge in exercises.		
			rstood content e.o	a. by using the vide
	 Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by u recordings of the lectures. 		, , ,	
	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and	120			
scale				
Assignment for the				
Following Curricula		am, 7 semester): Core Qualification: Compulsor	У	
	Energy and Environmental Engineering: Cor			
	General Engineering Science (English progra			
	Logistics and Mobility: Core Qualification: Co			
	Mechanical Engineering: Core Qualification:			
	Mechatronics: Core Qualification: Compulsor			
	Naval Architecture: Core Qualification: Comp			
	Technomathematics: Specialisation III. Engin	leering science: Elective compulsory		

_			
	ecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers		
Language	DE		
Cycle	SoSe		
Content	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		
	• Springs		
	• Axis & shafts		
Literature			
	 Dubbel, Taschenbuch f ür 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. Sourie weitere Bücher zu gestiellen Themen		
	Sowie weitere Bücher zu speziellen Themen		

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

Courses				
Title		Тур	Hrs/wk	СР
Mechanics II (L0493)		Lecture	2	2
Mechanics II (L0494)		Recitation Section (small)	2	2
Mechanics II (L1691)		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements				
Recommended Previous	Mechanics I			
Knowledge				
	After taking part successfully, students	s have reached the following learning results		
Professional Competence				
Knowledge	The students name the fundamental co	oncepts and laws of statics such as stresses, strains, Ho	ooke's linear law.	
Skills	The students apply the mathematical/	mechanical analysis and modeling.		
	The students apply the fundamental m	ethods of elasto statics to simply engineering problem	s.	
	The students estimate the validity and	limitations of the introduced methods.		
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Tim	ne in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German	program): Core Qualification: Compulsory		
Following Curricula	General Engineering Science (German	program, 7 semester): Core Qualification: Compulsory		
	Civil- and Environmental Engineering:	Core Qualification: Compulsory		
	Mechanical Engineering: Core Qualifica	ation: Compulsory		
	Mechatronics: Core Qualification: Com	pulsory		
	Naval Architecture: Core Qualification:	Commutation		

Course L0493: Mechanics II	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	stresses and strains
	Hooke's law
	tension and compression
	torsion
	bending
	stability
	buckling
	energy methods
Literature	 Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 1, Springer Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2 Elastostatik, Springer

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

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

Module M0671: Techr	ical Thermodynamics I			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics I (L043	7)	Lecture	2	4
Technical Thermodynamics I (L043	9)	Recitation Section (large)	1	1
Technical Thermodynamics I (L044)	1)	Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous	Elementary knowledge in Mathematics and M	echanics		
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Therm	nodynamics. They know the relation of the kin	ds of energy acc	ording to 1 st law
		nits of energy conversions according to 2 nd law		
		cess variables and know the meaning of diffe	-	-
	-	exergy and anergy. They are able to draw th		
		erence between an ideal and a real gas and a		
		tal state of equation and know the basics of two		
Skills	Students are able to calculate the internal en	nergy, the enthalpy, the kinetic and the potenti	al energy as well	as work and heat
SKIIIS		lations for the Carnot cycle. They are able to ca		
	for a real gas from measured thermal state va		fediate state van	
	for a real gas norm measured merman state w	andores.		
Personal Competence				
-	The students are able to discuss in small area	inc and doubles an approach		
	The students are able to discuss in small grou			find ways to use t
Autonomy		sks, to get new knowledge from existing knowle	euge as well as to	inna ways to use t
	knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time in L	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German progra	m): Core Qualification: Compulsory		
Following Curricula		m, 7 semester): Core Qualification: Compulsory		
-	Bioprocess Engineering: Core Qualification: Co			
	Energy and Environmental Engineering: Core			
	General Engineering Science (English program			
		n, 7 semester): Core Qualification: Compulsory		
		cialisation Engineering Sciences: Elective Comp	ulsory	
	Mechanical Engineering: Core Qualification: C	5 5 1	-	
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compu			
	Technomathematics: Specialisation III. Engine			
	Process Engineering: Core Qualification: Com			

Course L0437: Technical The	rmodynamics I
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	SoSe
Content	1. Introduction
	2. Fundamental terms
	3. Thermal Equilibrium and temperature
	3.1 Thermal equation of state
	4. First law
	4.1 Heat and work
	4.2 First law for closed systems
	4.3 First law for open systems
	4.4 Examples
	5. Equations of state and changes of state
	5.1 Changes of state
	5.2 Cycle processes
	6. Second law
	6.1 Carnot process
	6.2 Entropy
	6.3 Examples
	6.4 Exergy
	7. Thermodynamic properties of pure fluids
	7.1 Fundamental equations of Thermodynamics
	7.2 Thermodynamic potentials
	7.3 Calorific state variables for arbritary fluids
	7.4 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: Technical The	ourse L0439: Technical Thermodynamics I	
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	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Module M0851: Math	ematics II			
Courses				
Title		True		CD
Title		Тур	Hrs/wk	CP
Analysis II (L1025)		Lecture	2	2
Analysis II (L1026)		Recitation Section (large)	1	1
Analysis II (L1027)		Recitation Section (small)	1	1
Linear Algebra II (L0915)		Lecture	2	2
Linear Algebra II (L0916)		Recitation Section (small)	1	1
-				
Linear Algebra II (L0917)	Г	Recitation Section (large)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous	Mathematics I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge				
	 Students can name further concepts in ana 	alysis and linear algebra. They are able	e to explain the	em using appropria
	examples.			
	 Students can discuss logical connections betw 	ween these concepts. They are capable	of illustrating th	ese connections wi
	the help of examples.		-	
	 They know proof strategies and can reproduce 	a thom		
	 They know proof strategies and carrieproduce 	e them.		
Skills				
	 Students can model problems in analysis and 	I linear algebra with the help of the conce	epts studied in t	his course. Moreove
	they are capable of solving them by applying	established methods.		
	 Students are able to discover and verify further 	er logical connections between the conce	ots studied in the	
	-			
	 For a given problem, the students can deve 	elop and execute a suitable approach, a	nd are able to c	ritically evaluate t
	results.			
Personal Competence				
Social Competence				
	 Students are able to work together in teams. 	They are capable to use mathematics as	a common langu	age.
	 In doing so, they can communicate new concerning 	epts according to the needs of their coop	erating partners	. Moreover, they c
	design examples to check and deepen the und	derstanding of their peers.		
Autonomy	 Students are capable of checking their under 	standing of complex concepts on their o	wn They can sr	ecify open questio
			will filley cull sp	ceny open questio
	precisely and know where to get help in solvin			
	 Students have developed sufficient persisten 	nce to be able to work for longer period	s in a goal-orien	ted manner on ha
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Analysis II) + 60 min (Linear Algebra II)			
scale				
	Conoral Engineering Science (Corman program); Co	ro Qualification: Compulson		
-	General Engineering Science (German program): Cor			
Following Curricula	5 5 7 7 5 7			
	Civil- and Environmental Engineering: Core Qualification	1 5		
	Bioprocess Engineering: Core Qualification: Compuls	ory		
	Electrical Engineering: Core Qualification: Compulsor	ry		
	Energy and Environmental Engineering: Core Qualifie	-		
		ication: Compulsory		
	Computational Science and Engineering: Core Qualif			
	Computational Science and Engineering: Core Qualificomputational Science and Engineering: Core Qualifi	ication: Compulsory		
	Computational Science and Engineering: Core Qualif Logistics and Mobility: Core Qualification: Compulsor	'y		
	Computational Science and Engineering: Core Qualif Logistics and Mobility: Core Qualification: Compulsor Mechanical Engineering: Core Qualification: Compuls	'y		
	Computational Science and Engineering: Core Qualif Logistics and Mobility: Core Qualification: Compulsor	'y		
	Computational Science and Engineering: Core Qualif Logistics and Mobility: Core Qualification: Compulsor Mechanical Engineering: Core Qualification: Compuls	'y		

Course L1025: Analysis II	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	 power series and elementary functions interpolation integration (proper integrals, fundamental theorem, integration rules, improper integrals, parameter dependent integrals applications of integration (volume and surface of bodies of revolution, lines and arc length, line integrals numerical quadrature periodic functions
Literature	 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1026: Analysis II	rse L1026: Analysis II	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

ourse L1027: Analysis II	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0916: Linear Algebra	a II		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner		
Language	DE		
Cycle	SoSe		
Content	 linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: QR-decomposition, normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition system of linear differential equations 		
Literature	 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 		

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

Module M0688: Techn	ical Thermodynamics II			
Courses				
Title		Тур	Hrs/wk	СР
Technical Thermodynamics II (L044	9)	Lecture	2	4
Technical Thermodynamics II (L045	0)	Recitation Section (large)	1	1
Technical Thermodynamics II (L045	1)	Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous	Elementary knowledge in Mathematics, Mechan	ics and Technical Thermodynamics I		
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
-	Students are familiar with different cycle processes like Joule, Otto, Diesel, Stirling, Seiliger and Clausius-Rankine. They are able to derive energetic and exergetic efficiencies and know the influence different factors. They know the difference between ant clockwise and clockwise cycles (heat-power cycle, cooling cycle). They have increased knowledge of steam cycles and are able to draw the different cycles in Thermodynamics related diagrams. They know the laws of gas mixtures, especially of humid ai processes and are able to perform simple combustion calculations. They are provided with basic knowledge in gas dynamics and know the definition of the speed of sound and know about a Laval nozzle.			
Skills	Students are able to use thermodynamic laws the exergy- and entropy balances and by this to operegard to an outflowing gas from a tank. The procedure.	ptimise technical processes. They are able to	perform simple	safety calculations i
Personal Competence	The students are able to discuss in small group:	s and develop an approach		
Social competence	The stadents are able to alseass in small group.			
Autonomy	Students are able to define independently tasks knowledge in practice.	s, to get new knowledge from existing knowle	dge as well as to	find ways to use th
Workload in Hours	Independent Study Time 124, Study Time in Lea	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program	7 semester): Core Qualification: Compulsory		
Following Curricula	Bioprocess Engineering: Core Qualification: Con			
-	Energy and Environmental Engineering: Core Q			
	General Engineering Science (English program,			
	Computational Science and Engineering: Specia		ilsory	
	Mechanical Engineering: Core Qualification: Cor		-	
	Mechatronics: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineer	ing Science: Elective Compulsory		
	Process Engineering: Core Qualification: Compu			

Course L0449: Technical Thermodynamics II	
Тур	Lecture
Hrs/wk	2
CP	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: Technical The	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: Technical Thermodynamics II	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Gerhard Schmitz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

6						
Courses				_		
Title		120		Тур	Hrs/wk	CP
lechanics III (Hydrostatics, Kinema lechanics III (Hydrostatics, Kinema				Lecture	3 2	3 2
lechanics III (Hydrostatics, Kinema				Recitation Section (small) Recitation Section (large)	1	2
Module Responsible					_	_
Admission Requirements						
Recommended Previous	Mathematics I,	II, Mechanics I (Statics)			
Knowledge	,	,	,			
Educational Objectives	After taking par	t successfully, student	ts have reached the follow	ing learning results		
Professional Competence						
Knowledge	The students ca	in				
	• doccribo	the evidentic procedu	ure used in mechanical cor	atovto		
				ilexis,		
		nportant steps in mod	-			
	• present t	echnical knowledge in	stereostatics.			
Skills	The students ca	in				
	a avalain t	ha immarkant alamant	a of mothematical (mach	anical analysis and model for	mation and annu	
			s of mathematical / meth	anical analysis and model for	nation, and appl	y it to the contex
		problems;	and the second later states are states at a	to an air a sain a san blanca		
	 apply basic hydrostatical, kinematic and kinetic methods to engineering problems; estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets. 					
	• estimate	the reach and bounda	ines of statical methods a	ia extena them to be applicat	ne to wider proble	em sets.
Personal Competence						
Social Competence	The students ca	in work in groups and	support each other to over	rcome difficulties.		
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those					
				-		
Workload in Hours		udy Time 96, Study Tii	me in Lecture 84			
Credit points Course achievement	6 Compulsory Bonu	is Form	Description			
Course achievement	No 20 9			WiSe angeboten		
Examination	Written exam	· · ·				
Examination duration and	120 min					-
scale						
Assignment for the	General Engine	ering Science (Germar	n program, 7 semester): Co	ore Qualification: Compulsory		
Following Curricula	Mechanical Eng	ineering: Core Qualific	ation: Compulsory			
2	-	Core Qualification: Com				
		ure: Core Qualification				
			. Engineering Science: Ele			

Course L1154: Mechanics III	(Hydrostatics, Kinematics, Kinetics I)
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	Hydrostatics
	Kinematics Kinematics of points and relative motion Planar and spatial motion of point systems and rigid bodies Dynamics Terms Fundamental equations Motion of the rigid body in 3D-space Dynamics of gyroscopes, rotors Realtive kinetics Systems with non-constant mass
	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3 und 4. 11. Auflage, Springer (2011).

Course 11125 Marchaules III	
Course L1135: Mechanics III	(Hydrostatics, Kinematics, Kinetics I)
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course
Course L1136: Mechanics III	(Hydrostatics, Kinematics, Kinetics I)
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	WiSe

Content

Literature

See interlocking course

See interlocking course

Module M0853: Math	ematics III			
Courses				
		_		
Title		Тур	Hrs/wk	СР
Analysis III (L1028)		Lecture	2	2
Analysis III (L1029)		Recitation Section (small)	1	1
Analysis III (L1030)		Recitation Section (large)	1	1
Differential Equations 1 (Ordinary I	Differential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary I	Differential Equations) (L1032)	Recitation Section (small)	1	1
Differential Equations 1 (Ordinary [Differential Equations) (L1033)	Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics I + II			
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
-				
Knowledge	 Students can name the basic concepts in t 	the area of analysis and differential equation	. They are able	to explain them us
			, mey are usie	
	appropriate examples.			
	 Students can discuss logical connections 	between these concepts. They are capable	of illustrating th	ese connections w
	the help of examples.			
	 They know proof strategies and can repro- 	duce them.		
Skills				
Diting.		of analysis and differential equations with th	e help of the co	ncepts studied in t
	course. Moreover, they are capable of solv	ving them by applying established methods.		
			ate studied in the	
		urther logical connections between the conce		
	 For a given problem, the students can d 	levelop and execute a suitable approach, a	nd are able to c	ritically evaluate t
	results.			
Personal Competence				
Social Competence				
	 Students are able to work together in tear 	ns. They are capable to use mathematics as	a common langu	age.
	 In doing so, they can communicate new c 	oncepts according to the needs of their coop	erating partners	. Moreover, they c
	design examples to check and deepen the	understanding of their peers		
		and rotaniang of their peersi		
Autonomy				
	 Students are capable of checking their un 	nderstanding of complex concepts on their o	wn. They can sp	ecify open question
	precisely and know where to get help in so	olving them.		
	 Students have developed sufficient persit 	stence to be able to work for longer period	s in a goal-orier	ited manner on ha
		stellee to be uble to work for longer period	s in a goar oner	
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lect	ture 112		
Credit points	8			
Course achievement	None			
	Written exam			
	60 min (Analysis III) + 60 min (Differential Equat	ions 1)		
scale				
	General Engineering Science (German program,			
Following Curricula	Civil- and Environmental Engineering: Core Quali			
	Bioprocess Engineering: Core Qualification: Com	· ·		
	Computer Science: Core Qualification: Compulso			
	Electrical Engineering: Core Qualification: Compu	•		
	Energy and Environmental Engineering: Core Qu			
	General Engineering Science (English program, 7			
	Computational Science and Engineering: Core Qu	ualification: Compulsory		
	Mechanical Engineering: Core Qualification: Com	pulsory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulso	ory		
	Naval Architecture: Core Qualification: Compulso Process Engineering: Core Qualification: Compuls	•		

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 III	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: Differential E	quations 1 (Ordinary Differential Equations)		
Тур	Lecture		
Hrs/wk	2		
CP			
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		
Litoraturo	 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 E	ourse L1032: Differential Equations 1 (Ordinary Differential Equations)			
Тур	Recitation Section (small)			
Hrs/wk	1			
CP	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Dozenten des Fachbereiches Mathematik der UHH			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			
Course L1033: Differential E	quations 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

Literature

See interlocking course

See interlocking course

Courses				
litle		Typ	Hrs/wk	СР
ntroduction to Control Systems (L	0654)	Typ Lecture	нг 5/wк 2	4
ntroduction to Control Systems (L		Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and	frequency domain, Laplace transform		
Knowledge				
	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	Students can represent dynamic system be	havior in time and frequency domain, and	can in particular	explain properties
	first and second order systems			
	 They can explain the dynamics of simple control 	ontrol loops and interpret dynamic propertie	es in terms of free	quency response ar
	root locus			
	They can explain the Nyquist stability criter			
	They can explain the role of the phase marging			
	 They can explain the way a PID controller at They can explain issues arising when control 			digitally
	 They can explain issues arising when control 		are implemented	uigitally
Skills	 Students can transform models of linear dyn 	namic systems from time to frequency dom	ain and vice vers	-a
	 They can simulate and assess the behavior 			a
	 They can design PID controllers with the hel 			
	 They can analyze and synthesize simple correctly 			e techniques
	They can calculate discrete-time approx			
	implementation			
	 They can use standard software tools (Matla 	ab Control Toolbox, Simulink) for carrying o	out these tasks	
Personal Competence				
	Students can work in small groups to jointly solve	technical problems, and experimentally va	lidate their contro	ller designs
Autonomy	Students can obtain information from provided s			
	when solving given problems.			
	when solving given problems.			y,
	when solving given problems. They can assess their knowledge in weekly on-line	e tests and thereby control their learning pr		
		e tests and thereby control their learning pr		,,
		e tests and thereby control their learning pr		- <u>-</u>
		e tests and thereby control their learning pr		,
Workload in Hours				
Credit points	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6			
Credit points Course achievement	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None			
Credit points Course achievement Examination	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam			
Credit points Course achievement Examination Examination duration and	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam			
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min	re 56	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7	re 56 semester): Core Qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Compu	re 56 semester): Core Qualification: Compulsory Jlsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Comput Computer Science: Specialisation Computational M	re 56 semester): Core Qualification: Compulsory Jlsory Jathematics: Elective Compulsory	ogress.	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Comput Computer Science: Specialisation Computational N Data Science: Core Qualification: Elective Compuls Electrical Engineering: Core Qualification: Compuls Energy and Environmental Engineering: Core Qual General Engineering Science (English program, 7	re 56 semester): Core Qualification: Compulsory Jlsory Aathematics: Elective Compulsory sory sory ification: Compulsory semester): Specialisation Electrical Enginee semester): Specialisation Civil Engineering:	ogress.	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Comput Computer Science: Specialisation Computational M Data Science: Core Qualification: Elective Compuls Electrical Engineering: Core Qualification: Comput Energy and Environmental Engineering: Core Qual General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 and Production: Compulsory	re 56 semester): Core Qualification: Compulsory ulsory Aathematics: Elective Compulsory sory sory ification: Compulsory semester): Specialisation Electrical Engineer semester): Specialisation Electrical Engineer semester): Specialisation Dioprocess Engine semester): Specialisation Dioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Computer Science , 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical semester): Specialisation Mechanical Engin h, 7 semester): Specialisation Mechanical Engin	ogress.	ry ing: Compulsory Focus Biomechania us Energy System tus Aircraft System terials in Engineeri Focus Mechatronia Product Developme
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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 L0654: Introduction t	
Тур	
Hrs/wk	
СР	
	Independent Study Time 92, Study Time in Lecture 28
	Prof. Herbert Werner
Language	
Cycle	
Content	Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus 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 Simith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers
	Software tools
	 Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course
Literature	 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, 200 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
Management Tutorial (L0882)		Recitation Section (large)	2	3
Introduction to Management (L088	0)	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	ollowing learning results		
Professional Competence				
Knowledge	a After taking this module, students know the important basics of many different areas in Business and Management, from Pla and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to			
Skills	 explain the differences between Economics and important definitions from the field of Management explain the most important aspects of and goals i projects describe and explain basic business functions a organization and human ressource management, in explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and select Students are able to analyse business units with respect to 	a Management and name the mos s production, procurement and s formation management, innovation making in Business, esp. in situa mathematical Finance ed controlling methods.	t important aspe ourcing, supply management ar tions under mul	cts of entreprneur chain managemen nd marketing tiple objectives a
	 out an Entrepreneurship project in a team. In particular, th analyse Management goals and structure them app analyse organisational and staff structures of comp apply methods for decision making under multiple of analyse production and procurement systems and E analyse and apply basic methods of marketing select and apply basic methods from mathematical apply basic methods from accounting, costing and of 	ropriately nies bjectives, under uncertainty and ur usiness information systems finance to predefined problems	nder risk	
Personal Competence Social Competence	Students are able to			
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to an entrie to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves to write a report on their project. 		oherent report on	the project
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination				
	several written exams during the semester			
scale				
	General Engineering Science (German program, 7 semeste			
Following Curricula	Civil- and Environmental Engineering: Core Qualification: C Civil- and Environmental Engineering: Specialisation Civil I Civil- and Environmental Engineering: Specialisation Wate Civil- and Environmental Engineering: Specialisation Traffi Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory	ngineering: Elective Compulsory and Environment: Elective Compu		
	Electrical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro): Specialisation Computer Science 	Compulsory ering: Compulson mental Engineer : Compulsory	ry ing: Compulsory
	General Engineering Science (English program, 7 seme Compulsory General Engineering Science (English program, 7 seme	·		
	[44]			

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 L08	82: Management Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload	Independent Study Time 62, Study Time in Lecture 28
in Hours	
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 se 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 busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.

rse L0880: Introduction t	o Management
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneliu
	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 in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovatio Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informatio Management Definitions as information, information systems, aspects of data security and strategic 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., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Au 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
	ship-accompanying Seminar (L2687)	Seminar	1	0
Advanced Internship AIW/ ES: Prep		Seminar	1	0
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	150 Creditpoints in General Engineering Sci	ence		
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students of the different specialisations get	experiences in typical scope of duties of e	engineers, who are worki	ing in a developm
	division, planning division or in the management of a company. In the framework of this environment the know		the knowledge fr	
	university can used a first time for real eng	ineering tasks.		
Chille	Chudonte of the different encodeligations of	and be interveted in tunical day/a wark	Du this they are leave	ing trutical tasks
Skills Students of the different specialisations should be integrated in typical day's work. By functions of engineers. They are able to structure and organize their working day and to f				
	functions of engineers. They are able to stit		to ministr tasks in a certa	ini time.
Personal Competence				
Social Competence	Students are able to cooperate with co-work	kers in a company and to understand the la	anguage of engineers.	
Autonomy	Students can finish own tasks.			
Workload in Hours	Independent Study Time 512, Study Time in	Lecture 28		
Credit points	18			
Course achievement	None			
Examination	Written elaboration (accord. to Internship R	egulations)		
Examination duration and				
scale				
Assignment for the	General Engineering Science (German prog	ram, 7 semester): Core Qualification: Com	pulsory	
Following Curricula	Engineering Science: Core Qualification: Cor	mpulsory		
	General Engineering Science (English progra			

Course L2687: Advanced Inte	enship AIW/ ES: Internship-accompanying Seminar
Тур	Seminar
Hrs/wk	1
СР	0
Workload in Hours	Independent Study Time -14, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried, Eilika Schwenke
Language	DE/EN
Cycle	WiSe/SoSe
	The aim of the internship-accompanying seminar is the acquisition and consolidation of competences relevant for successfully doing the advanced internship in the 7th semester. The target group is students who already have found an internship placement. The focus is on strengthening personal competences to support the successful development of professional competences. In the seminar, students reflect on current challenges in relation to the internship. They discuss current topics with fellow students and teachers with the method of collegial counselling (peer-to-peer approach); in this way they gain (additional) self-confidence and increase their chances of successfully contributing in the internship, recognising and expressing their own wishes and needs in order to optimally use the internship for their own theory-practice transfer. The selection of topics is process-oriented and controlled by the group; the teachers provide impulses for reflection on certain topics. Topics that are dealt with are, for example: Negotiating the employment contract, Successful start into the internship - how do I behave in the first few days, How do I get interesting tasks, How do I deal with difficult situations (e.g. conflicts, sexism, racism), How do I note my progress/write the internship report? Through the intensive exchange with fellow students, the students also gain insights into the internships of their peers. This gives them an impression of their professional opportunities far beyond their own internship. The concrete application example of the advanced internship thus promotes the acquisition and consolidation of competences in career management skills that can be transferred to later career steps.
Literature	
Literature	

Course L2682: Advanced Inte	rnship AIW/ ES: Preparation
Тур	Seminar
Hrs/wk	1
СР	0
Workload in Hours	Independent Study Time -14, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried, Eilika Schwenke
Language	DE/EN
Cycle	WiSe/SoSe
	The aim of the internship preparation (recommended in the 5th semester) is to acquire competences that are relevant for successfully searching for and doing the advanced internship in the 7th semester. Participation increases the students' chances of finding an internship of at least three months length and, if applicable, in English language, at the specified time. It also serves as a networking opportunity for the AIW/ES students. Participation in the 5th semester is recommended for a timely internship application.
	The seminar focuses on the topics of internship search, application and transfer competence. The students reflect on their already existing competences, skills and interests and learn which different employers are available for the engineering profession and how to find them. They continue to reflect on which topics of their studies they would like to try out in practical transfer in activities (theory-practice transfer) and look for suitable employers (if necessary under guidance). Contact is made with companies and other employers in the Hamburg metropolitan region who are potential employers for TUHH graduates. The students are supported in creating an appealing CV and cover letter. They practise presenting themselves in a job interview and complete a mock interview. They receive feedback from their fellow students and the teachers, gain self-confidence and increase their chances of finding an internship that is a good fit for them.
	The seminar strengthens the students' independence. The concrete application example of the advanced internship promotes the acquisition and consolidation of competences of career management skills, which can be transferred to later career steps. It also contributes to the interaction of theory and practice. Transfer in this context is "the successful application of previously acquired knowledge or skills in the context of a new requirement not yet apparent in the situation of knowledge or skill acquisition." Hasselhorn/Gold 2017
Literature	

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: Princ	ples of Building Materials a	nd Building Physics		
Courses				
Title		Тур	Hrs/wk	СР
Building Physics (L0217)		Lecture	2	2
Building Physics (L0219)		Recitation Section (large)	1	1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materials (L02	215)	Lecture	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Knowledge of physics, chemistry and ma	thematics from school		
Knowledge				
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence				
Knowledge	The students are able to identify fundam	ental effects of action to materials and structures, t	o explain different	types of mechanica
	behaviour, to describe the structure o	of building materials and the correlations betwee	n structure and	other properties, t
	show methods of joining and of corrosion processes and to describe the most important regularities and properties of bui			properties of buildin
	materials and structures and their measu	urement in the field of protection against moisture,	coldness, fire and	noise.
Chille	The students are able to walk with the	ment important standardined methods and requise	tion in the field of	maisture protostion
SKIIIS	5 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.			
	the German regulation for energy saving	, the protection and holse protection in the case of	a small bullding.	
Personal Competence				
Social Competence	The students are able to support each ot	her to learn the very extensive specialist knowledge	2.	
Autonomy	The students are able to make the timing	g and the operation steps to learn the specialist kno	wledge of a very e	extensive field.
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2 h written exam			
scale				
Assignment for the	General Engineering Science (German pr	rogram, 7 semester): Specialisation Civil Engineering	g: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Co	pre Qualification: Compulsory		
	General Engineering Science (English pro	ogram, 7 semester): Specialisation Civil Engineering	: Compulsory	
	Orientierungsstudium: Core Qualification	a: Elective Compulsory		
	Technomathematics: Specialisation III. En	ngineering Science: Elective Compulsory		

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

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

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

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

Module M0740: Struc	tural Analysis	I			
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	Mechanics I, Mathen	natics I			
Knowledge					
Educational Objectives	After taking part suc	cessfully, students have re	eached the following learning results		
Professional Competence					
Knowledge	After successfully co	mpleting this module, stu	dents can express the basic aspects of linear	r frame analysis of s	tatically determinat
	systems.				
Skille	After successful con	poletion of this module, th	e students are able to distinguish between s	statically determinat	e and indeterminat
JKIIIS			riables and to construct influence lines of	-	
	frame and truss stru	-	hables and to construct influence intes of	statically acternina	
Personal Competence					
Social Competence	Students can				
		subject-specific and interc			
		own work results in front of			
		scientific development of c	professional constructive criticism		
	 Furthermore, 	they can give and accept			
Autonomy	The students are al	ole work in-term homewor	k assignments. Due to the in-term feedbac	ck, they are enabled	d to self-assess the
	learning progress du	iring the lecture period, all	ready.		
Workload in Hours	Indopondont Study	Fime 124, Study Time in Le	octuro 56		
Credit points	6	Time 124, Study Time in E			
Course achievement	-	Form	Description		
course demeterment	No 10 %	Written elaboration	Hausübungen mit Testat, betreut durch	h Studentische Tutor	en (Tutorium)
Examination	Written exam				
Examination duration and	90 Minuten				
scale					
Assignment for the	General Engineering	Science (German program	n, 7 semester): Specialisation Civil Engineeri	ing: Compulsory	
Following Curricula	General Engineering	Science (German program	n, 7 semester): Specialisation Civil Engineeri	ing: Compulsory	
	Civil- and Environme	ental Engineering: Core Qu	alification: Compulsory		
	Civil- and Environme	ental Engineering: Core Qu	alification: Compulsory		
			, 7 semester): Specialisation Civil Engineerir		
			, 7 semester): Specialisation Civil Engineerir	ng: Compulsory	
			ering Science: Elective Compulsory		
	rechnomathematics	: Specialisation III. Enginee	ering Science: Elective Compulsory		

Course L0666: Structural Ana	alysis I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	 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
Literature	Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999.

Course L0667: Structural Ana	ırse L0667: Structural Analysis I				
Тур	itation Section (large)				
Hrs/wk	2				
CP	3				
Workload in Hours	pendent Study Time 62, Study Time in Lecture 28				
Lecturer	Prof. Uwe Starossek				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Courses					
Title		Тур	Hrs/wk	СР	
Project Seminar Concrete I (L0896)		Seminar	1	1	
Reinforced Concrete Design I (L030	3)	Lecture	2	3	
Reinforced Concrete Design I (L030	5)	Recitation Section (large)	2	2	
Module Responsible	Prof. Günter Rombach				
Admission Requirements	None				
Recommended Previous	Basic knowledge in structural analysis and	building materials.			
Knowledge					
Educational Objectives	After taking part successfully, students have	ve reached the following learning results			
Professional Competence					
Knowledge	The students can outline the history of con	crete construction and explain the basics of strue	ctural engineering,	including usual I	
	combinations and safety concepts. They are able to draft and dimension simple structures, as well as to evaluate and discuss the				
	behaviour of the materials and of structural members.				
		I members.			
		l members.			
		l members.			
Skills	behaviour of the materials and of structura		actical cases. They	are capable to d	
Skills	behaviour of the materials and of structura The students are able to apply basic proce	edures of the conception and dimensioning to pra			
Skills	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig	dures of the conception and dimensioning to pra n them for bending and bending with axial fo	orce, and to plan		
Skills	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig	edures of the conception and dimensioning to pra	orce, and to plan		
Skills	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig	dures of the conception and dimensioning to pra n them for bending and bending with axial fo	orce, and to plan		
	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig	dures of the conception and dimensioning to pra n them for bending and bending with axial fo	orce, and to plan		
Personal Competence	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig	dures of the conception and dimensioning to pra n them for bending and bending with axial fo	orce, and to plan		
Personal Competence Social Competence	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design	edures of the conception and dimensioning to pra n them for bending and bending with axial f n and construction sketches and draw up technice	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design	dures of the conception and dimensioning to pra n them for bending and bending with axial fo	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design	edures of the conception and dimensioning to pra n them for bending and bending with axial for n and construction sketches and draw up technica asks in the conception and dimensioning of struct	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design The students are able to carry out simple to Independent Study Time 110, Study Time i	edures of the conception and dimensioning to pra n them for bending and bending with axial for n and construction sketches and draw up technica asks in the conception and dimensioning of struct	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design The students are able to carry out simple to Independent Study Time 110, Study Time i 6 Compulsory Bonus Form	edures of the conception and dimensioning to pra n them for bending and bending with axial for n and construction sketches and draw up technica asks in the conception and dimensioning of struct	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours Credit points	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design The students are able to carry out simple to Independent Study Time 110, Study Time i 6	edures of the conception and dimensioning to pro- n them for bending and bending with axial for n and construction sketches and draw up technice asks in the conception and dimensioning of struct n Lecture 70	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement	behaviour of the materials and of structura The students are able to apply basic proce simple concrete structures and to desig execution. Moreover, they can make design The students are able to carry out simple to Independent Study Time 110, Study Time i 6 Compulsory Bonus Form	edures of the conception and dimensioning to pro- n them for bending and bending with axial for n and construction sketches and draw up technice asks in the conception and dimensioning of struct n Lecture 70	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement	behaviour of the materials and of structural The students are able to apply basic processimple concrete structures and to designed execution. Moreover, they can make designed to the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the structure and the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure in the structure is a structure in the struc	edures of the conception and dimensioning to pro- n them for bending and bending with axial for n and construction sketches and draw up technice asks in the conception and dimensioning of struct n Lecture 70	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	behaviour of the materials and of structural The students are able to apply basic processimple concrete structures and to designed execution. Moreover, they can make designed to the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the structure and the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure is a structure in the structure in t	edures of the conception and dimensioning to pro- n them for bending and bending with axial for n and construction sketches and draw up technice asks in the conception and dimensioning of struct n Lecture 70	orce, and to plan al descriptions.	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination duration and	behaviour of the materials and of structural The students are able to apply basic processimple concrete structures and to designed execution. Moreover, they can make designed to the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the structure and the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the st	edures of the conception and dimensioning to pro- n them for bending and bending with axial for n and construction sketches and draw up technice asks in the conception and dimensioning of struct n Lecture 70	orce, and to plan al descriptions. tures and to critica	their detailing	
Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	behaviour of the materials and of structural The students are able to apply basic processimple concrete structures and to designed execution. Moreover, they can make designed to the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the students are able to carry out simple to a structure in the structure and the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the structure in the structure is a structure in the st	edures of the conception and dimensioning to pro- n them for bending and bending with axial for n and construction sketches and draw up technice asks in the conception and dimensioning of struct n Lecture 70 Description	orce, and to plan al descriptions. tures and to critica	their detailing	

Тур	Seminar			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Dr. Björn Schütte			
Language				
Cycle	Se			
Content	the course of the project seminar, a simple structure is drafted and dimensioned.			
Literature	Download der Unterlagen zur Vorlesung über Stud.IP!			

Course L0303: Reinforced Co	ncrete Design I					
Тур	Lecture					
Hrs/wk	2					
СР						
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 Betontragwerken 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 von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sohn, Berlin 1978 					

ourse L0305: Reinforced Concrete Design I			
Тур	itation Section (large)		
Hrs/wk			
CP			
Workload in Hours	ependent Study Time 32, Study Time in Lecture 28		
Lecturer	f. Günter Rombach		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses						
Title			Тур	Hrs/wk	СР	
Building Materials and Building Chemistry (L0248)			Lecture	4	4	
Building Materials and Building Che	emistry (L0249)		Recitation Section (sm	all) 1	2	
Module Responsible	Prof. Frank Schmidt	t-Döhl				
Admission Requirements	None					
Recommended Previous	Module Principles of	f Building Materials and Bui	lding Physics			
Knowledge						
Educational Objectives	After taking part su	ccessfully, students have re	ached the following learning results			
Professional Competence						
Knowledge		he mechanical behaviour a	t important components, the manuf nd the corrosion behaviour, the mater			
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 concreated to consider the mixture in respect to the actual rules and the connections between the characteristic concrete parameter. They are able to select suitable materials and mixtures to avoid damage processes.					
Personal Competence						
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge in learning groups and to carry o exercises in small groups in the lab.					
Autonomy	The students are at	ble to make the timing and	he operation steps to learn the special	ist knowledge of a very	extensive field.	
Workload in Hours	Independent Study	Time 110, Study Time in Le	cture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	No 10%	Presentation				
Examination	Written exam					
Examination duration and	2 h written exam					
scale	Concept Engine anti-		7 competents Cresiellection Chill Frank	a a sin a Canan da a		
Assignment for the	5		n, 7 semester): Specialisation Civil Engin			
Following Curricula	-	g Science (German program iental Engineering: Core Qu	n, 7 semester): Specialisation Civil Engin	eening. compulsory		
			7 semester): Specialisation Civil Engin	eering: Compulsory		
	-		7 semester): Specialisation Civil Engin			

Course L0248: Building Mate	erials and Building Chemistry					
Тур	Lecture					
Hrs/wk						
CP	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 Mate	urse L0249: Building Materials and Building Chemistry			
Тур	itation Section (small)			
Hrs/wk				
CP				
Workload in Hours	pendent Study Time 46, Study Time in Lecture 14			
Lecturer	f. Frank Schmidt-Döhl, Andre Rössler			
Language				
Cycle	SoSe			
Content	e interlocking course			
Literature	See interlocking course			

Module M0706: Geote	echnics I				
Courses					
Title			Түр	Hrs/wk	СР
Soil Mechanics (L0550)			Lecture	2	2
Soil Mechanics (L0551)			Recitation Section (large)	2	2
Soil Mechanics (L1493)			Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules :				
Knowledge	Mechanics I-II				
Educational Objectives	After taking part successfully	, students have reache	d the following learning results		
Professional Competence					
Knowledge	The students know the basic	s of soil mechanics as	he structure and characteristics of soil, s	tress distribution	due to weight, water
	or structures, consolidation a	and settlement calculat	ions, as well as failure of the soil due to g	round- or slope fa	ailure.
Skills	After the successful complet	ion of the module the	students should be able to describe the r	mechanical prope	erties and to evaluate
	them with the help of geot	echnical standard tests	s. They can calculate stresses and defor	rmation in the so	oils due to weight or
	influence of structures. They	are are able to prove t	he usability (settlements) for shallow four	ndations.	
Personal Competence					
Social Competence					
Autonomy					
	Independent Study Time 96,	Study Time in Lecture	84		
Credit points		-			
Course achievement	Compulsory Bonus Form	I	Description		
	No 20 % Attes	tation			
Examination	Written exam				
Examination duration and	60 minutes				
scale					
Assignment for the	General Engineering Science	(German program, 7 s	emester): Specialisation Civil Engineering	: Compulsory	
Following Curricula	General Engineering Science	(German program, 7 s	emester): Specialisation Civil Engineering	: Compulsory	
	Civil- and Environmental Eng	ineering: Core Qualifica	ation: Compulsory		
	Civil- and Environmental Eng	ineering: Core Qualifica	ation: Compulsory		
	General Engineering Science	(English program, 7 se	mester): Specialisation Civil Engineering:	Compulsory	
	General Engineering Science	(English program, 7 se	mester): Specialisation Civil Engineering:	Compulsory	
	Technomathematics: Special	isation III. Engineering	Science: Elective Compulsory		
	Technomathematics: Specia	isation III. Engineering	Science: Elective Compulsory		

Course L0550: Soil Mechanics		
Тур	Lecture	
Hrs/wk	2	
CP	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 Mechanics	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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

Courses						
Title			Ţ	ур	Hrs/wk	СР
Structural Analysis II (L0673)			Le	ecture	2	3
Structural Analysis II (L0674)			Re	ecitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek					
Admission Requirements	None					
Recommended Previous	Mechanics I/II					
Knowledge	Mathematics I/II					
	Differential Equations I					
	 Structural Analysis I 					
Educational Objectives	After taking part successfully, s	tudents have re	ached the following	learning results		
Professional Competence						
Knowledge	After successful completion of	f this module,	students can expr	ess the basic aspects	of linear frame a	nalysis of statica
	indeterminate systems.					
Skills	After successful completion of	this module, th	e students are able	e to analyze state variab	les and to constru	ict influence lines
	statically inderminate plane an	d spatial frame a	and truss structures.			
Personal Competence						
Social Competence	Students can					
Social competence	Stadents can					
	 participate in subject-spectrum 	ecific and interdi	sciplinary discussior	۱S,		
	 defend their own work re 					
	 promote the scientific de 		-			
	 Furthermore, they can g 	ve and accept p	orofessional construc	tive criticism.		
Autonomy	The students are able to work	in-term homewo	ork assignments. Du	e to the in-term feedbac	k, they are enable	d to self-assess th
,	learning progress during the le					
Workload in Hours	Independent Study Time 124, 9	itudy Time in Le	cture 56			
Credit points	6					
Course achievement		alabarati	Description	ik Teekek hetered der 1 d	Chudenkie-b Tot	an (Tutarium)
		elaboration	Hausubungen m	nit Testat, betreut durch s	Studentische Tutor	en (Tutorium)
Examination	Written exam					
Examination duration and	90 Minuten					
scale Assignment for the	General Engineering Science (C	erman program	7 competer): Crasi	alisation Civil Engineerin	a: Compulsory	
	General Engineering Science (C General Engineering Science (C					
i snowing curricula	Civil- and Environmental Engine				g. compuisory	
	Civil- and Environmental Engine	-				
	General Engineering Science (E	5		,	I: Compulsory	
	General Engineering Science (E					

Course L0673: Structural Ana	alysis II
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	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

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

Module M0611: Steel	Structures I			
Courses				
Title		Тур	Hrs/wk	СР
Steel Structures I (L0299)		Lecture	2	3
Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Structural analysis I, Structural analysis II			
Knowledge	Mechanics I, Mechanics II			
	Building Materials and Building Chemistry			
	Principles of Building Materials and Building	Physics		
Educational Objectives	After taking part successfully, students have reach	ad the following learning results		
	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	After passing this module students are able to			
Knowledge	After passing this module students are able to			
	 give a summary of the security concept 			
	explain the priciples of the design process			
	describe and illustrate the bhaviour of memory	ers in tension, compression and bending		
Skills	Students can rate and apply the material steel app	ropiately with respect to its properties an	d usage.	
	They can use the security concept with respect to I	oads, forces and resistances.		
	They can check the ultimate limit state and the ser	viceability of simple members in tension,	compression and	bending.
Personal Competence				
Social Competence	After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be			
	successful in guided building a truss with bolted co	nnections according to design drawings.		
Autonomy				
Workload in Hours		e 56		
Credit points	6			
Course achievement	None			
	Written exam			
Examination duration and	120 minutes			
scale				
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory			
Following Curricula	Civil- and Environmental Engineering: Core Qualific			
	General Engineering Science (English program, 7 se	emester): Specialisation Civil Engineering	: Compulsory	
Course L0299: Steel Structur	res			
	Lecture			
Hrs/wk				
CP	3			
	Independent Study Time 62, Study Time in Lecture	28		
	Bref. Margue Butther			

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

Courses			
Title	Тур	Hrs/wk	СР
Applied Structural Dynamics (L079)		2	2
Soil Laboratory Course (L0499)	Practical Course	1	2
Building Information Modeling (L19		1	1
Building Information Modeling (L19		ng 2	2
Computational Analysis of Structure		2	3
Introduction in Statitics with R (L02		1	1
Introduction in Statitics with R (L07		1	1
Principles of Geomatics (L0470)	Lecture	2	2
Principles of Geomatics (L0471)	Recitation Section (small)	2	2
Numeric and Matlab (L0125)	Practical Course	2	2
Practical Course in Drinking Water	Chemistry (L1744) Practical Course	1	2
Projects II (L1228)	Project Seminar	2	2
Special topics of Civil- and Environr		1	1
Special topics of Civil- and Environr	nental Engineering 2 LP (L2412)	2	2
Special topics of Civil- and Environr		3	3
Fire Protection and Prevention (L04	72) Lecture	2	2
Module Responsible	Prof. Peter Fröhle		
Admission Requirements	None		
Recommended Previous	none		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	The students are at home doing with typical applications of the study programme.		
Skills	Skills The students are able to use the methods that are provided during the lectures for practical questions. They are able to		re able to work in t
	learnt methods into new forms of application independently".		
Personal Competence			
Social Competence	According to the course chosen students are able to perform tasks or to conduct a proje	ct in teams. If s	o, they can prese
	discuss and document results accordingly.		
4.4	A second is a few the second schemes in this is the backward of the second descence with the share and second f		(th t
Autonomy	According to the course chosen individual students can plan and document tasks and work flow for themselves or for the team.		
	Depends on choice of courses		
Workload in Hours			
Workload in Hours Credit points	6		
	6 General Engineering Science (German program, 7 semester): Specialisation Civil Engineering	: Elective Compul	sory
Credit points	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering	: Elective Compul	sory

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

Course L0499: Soil Laborator	ry Course
Тур	Practical Course
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and	Die gesamte Arbeitszeit im Praktikum plus anschließender Bericht = 90 Stunden Arbeitszeit (Das Erstellen der Ausarbeitung =
scale	Bearbeitungszeitraum von 4 Wochen und ein Umfang von maximal 50 Seiten.)
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

Course L1903: Building Infor	mation Modeling
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and	siehe Modulhandbuch
scale	
Lecturer	Prof. Kay Smarsly, Prof. Frank Schmidt-Döhl, Thomas Kölzer
Language	DE
Cycle	WiSe/SoSe
Content	Basic knowledge of Building Information Modeling:
	 Introduction to BIM (development, backgrounds, history, opportunities, risks, levels)
	Current standards and guidelines (national and international standardisation, structures)
	Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats)
	Object oriented modeling (requirements, structure, classification, parts catalogues)
	BIM-Implementation (structures, cycles, professions, job profiles, execution plan)
	BIM-Tools (software, hardware, application areas)
	Execution examples (national and international construction projects)
	Basic knowledge for the use of the software Allplan 2018:
	 Basic settings (project administration, building structures, fileset structures, layers)
	Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.)
	Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.)
	 Dimensioning and text adding of designed elements and structural components
	Generating of areas (hatchings, patterns, fills)
	Construction fundamentals 3D (floor concept, floor manager, building structures)
	Walls and columns (height definitions, parameters, attributes, format properties)
	Slabs (height definitions, parameters, attributes, format properties)
	Use of libraries (u. a. furnitures, surroundings etc.)
	Opening Elements and SmartParts (doors and windows)
	Stairs and ramps (stair wizard, IFC-Ramp)
	 Roof frame and roof covering (custom planes, parameters, attributes, format properties)
	 Attributes and characteristic values (allocations and modifications)
	 Export and Import of IFC-Data (basics, floor allocation, fileset selection)
	 Generating of sections and views (architecturial sections and associative sections)
	Generating of printable drawings (layouts, scales, page settings)
Literature	-

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

Course L0370: Computationa	Il Analysis of Structures
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	
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 aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)

Course L0286: Introduction i	n Statitics with R
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Dr. Joachim Behrendt
Language	DE
Cycle	WiSe
Content	Introduction to R
	Graphics with R
	Descriptive Statistic (Boxplot, Percentiles, outliers)
	Propability (Combinatorics, relative frequency, dependand probability)
	random numbers and distibutions (confidence interval, uniform and discrete distributions, test-distributions (t-F-X ² -distribution))
	Correlation and Regression analysis (Confidence interval of calibration curves, linearity)
	Statistic test procedures (mean value-t-Test, Chi^2-Test, F-Test)
	Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test)
	Introduction time series (tseries)
	Introduction cluster analysis (k-means)
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
	Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge
	von Toutenburg, Helge 2008
	http://dx.doi.org/10.1007/978-3-540-77510-2http://dx.doi.org/10.1007/978-3-540-77510-2
	R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran.r-project.org/doc/contrib/Short-refcard.pdf
	Grafiken und Statistik in R von Andreas Plank
	Nachschlage Skript mit Beispielen: http://www.geo.fu
	berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdfhttp://www.geo.fu- berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf

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

Course L0470: Principles of C	Geomatics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur
scale	
Lecturer	Dr. Annette Scheider
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.: Vermessungskunde für den Planungs- Bau- und Umweltbereich, Wichmann-verlag Witte, B. / Sparla, P.: Vermessungskunde und Grundlagen der Statistik für das Bauwesen, Wichmann-Verlag Gruber, F.J. / Joeckel, R.: Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag

Course L0471: Principles of Geomatics	
Тур	Recitation Section (small)
Hrs/wk	2
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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and	5 Übungsaufgaben jeweils mit Testat am Ende
scale	
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): Moler, C., Numerical Computing with MATLAB, SIAM, 2004 The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

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

Course L1228: Projects II	
Тур	Project Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	ca. zehnminütige Präsentation
scale	
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	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
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	Course L2412: Special topics of Civil- and Environmental Engineering 2 LP	
Тур		
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	laut FSPO	
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt	
scale		
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 L2413: Special topics of Civil- and Environmental Engineering 3LP	
Тур	
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
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 Protection and Prevention		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and	20 min	
scale		
Lecturer	Philipp Below, Ulrich Körner	
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 M0631: Reinf	orced Concrete	Structures	I			
Courses						
Title Project Concrete Structures II (L089 Concrete Structures II (L0348) Concrete Structures II (L0349)	94)			Typ Project Seminar Lecture Recitation Section (large)	Hrs/wk 1 2 2	CP 1 3 2
Module Responsible	Prof. Günter Rombac	h		Reclation Section (large)	E .	-
Admission Requirements	None					
Recommended Previous Knowledge	Basics of safetKnowledge in	y format are requin design of beams ar	d columns for ultimate			
Educational Objectives	After taking part suce	cessfully, students	have reached the follow	ing learning results		
Professional Competence	5 1 5 1 1 1 1	,		5		
Knowledge Skills	 methods to estimate The students serviceability The students of 	the member forces can design reinfo limit state (crack an can estimate the m	s in simple one and two-	e in the ultimate limit state cluding detailing (anchorage a slabs.	(shear, bending,	
Personal Competence Social Competence Autonomy	Cooperation in a proj	ect work, where th	ey design in a team a re	al concrete building and pres	ent the results at	the end.
Workload in Hours	Independent Study T	ime 110. Study Tin	ne in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Excercises				
	Written exam					
Examination duration and scale	120 minutes					
Assignment for the	General Engineering	Science (German r	rogram 7 semester): Si	pecialisation Civil Engineering	- Elective Compu	leony
Following Curricula	General Engineering Civil- and Environme Civil- and Environme Civil- and Environme Civil- and Environme	Science (German p ntal Engineering: C ntal Engineering: S ntal Engineering: S ntal Engineering: S	rogram, 7 semester): S ore Qualification: Comp pecialisation Civil Engin pecialisation Traffic and pecialisation Water and	pecialisation Civil Engineering ulsory	: Elective Compu y ılsory	lsory
Course L0894: Project Concr					F. S.	-

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

Course L0348: Concrete Structures II			
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	 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. 		

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

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			
Recommended Previous	Mathematics I, II and III			
Knowledge	Mechanics I und II			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	The students are able to define the basic terms of hydromechanics, hydrology groundwater hydrology and water managemer They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to descril and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a un hydrograph.			
Skills	<i>Ils</i> The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Furthermore, able to run, explain and document basic hydraulic experiments.			urthermore, they a
	Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems.			
	In addition, the basic concepts of field-measurements of hydrological and hydrodynamic values can be described and the student 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 their results sustainably in plenary sessions by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentation for given topics in groups.			
Autonomy	Students are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline- specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): S Civil- and Environmental Engineering: Core Qualification: Comp General Engineering Science (English program, 7 semester): Sp	ulsory		

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

Course L0615: Hydromechan	ics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Fundamentals of Hydromechanics
	 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.

Course L0616: Hydromechanics	
Тур	Project-/problem-based Learning
Hrs/wk	1
CP	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

Module M0628: Wate	r Management			
Courses				
Title		Тур	Hrs/wk	СР
Groundwater Hydrology (L0251)		Lecture	1	1
Groundwater Hydrology (L0252)		Recitation Section (large)	1	2
Water Management and Water Qua	ality (L0366)	Lecture	2	3
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Mathemaics I to III; Water Engineering I, Ch	hemistry		
Knowledge				
Educational Objectives	After taking part successfully, students have	After taking part successfully, students have reached the following learning results		
Professional Competence				
Skills Personal Competence Social Competence	Students are able to define terms of the hydrologic cycle and also parameters to identify the water quality. Typical aquifer types and the occuring flow and storage processes can be explained technically. They are able to derive the Darcy law and the mathematical description of flow processes as well as their solution. They are in a position to explain the physical background of well hydraulics. Fundamentals of solute transport can be reflected. Students are able to use fundamental relationships of hydrology and water management for the solution of practical issues. The are in a position to rate water quality data and to set up hydrological water balances. They are able to construct ground water contour lines and streamlines on the basis of head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydraulic conductivities and storage coefficients. Students are able to help each other solving case studies. Are not imparted in this module.			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Civil Engineering	g: Elective Compu	lsory
Following Curricula	Civil- and Environmental Engineering: Core	e Qualification: Compulsory		
	General Engineering Science (English prog			

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

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

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

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Courses				
Title	Ty		Hrs/wk	CP
Basics in Structural Design (L0209)		oject-/problem-based Learning cture	2	4
Basics of Structural Design (L0205) Basics in Structural Design (L0208)		citation Section (large)	1	1
Module Responsible		initiation beeclon (large)	-	-
Admission Requirements	None			
Recommended Previous	Contents of module "Principles of Building Materials and Building Ph	vsics"		
Knowledge		,		
	After taking part successfully, students have reached the following I	learning results		
Professional Competence		5		
	After attending the "Building Construction" module students are abl	e		
	 to define the basics of building regulations law 			
	 to explain load effects and associated concepts 			
	 to describe overriding conventions of the construction industr 	ry		
	 to specify typical building components 			
	• to distinguish between different possibilities of load bearing b	behaviour and risks due to lac	k of stability	
	• to explain the main objectivs of fire control.			
Skills	After the successful completion of the "Building Construction" module, students will be able			
	 to apply industry-specific drawing conventions 			
	carry out preliminary dimensioning of basic building component	ents		
	 develop stability and foundation concepts 			
	use BIM software			
	 and to design and construct standard cross-sections due to st 	tructural aspects.		
Personal Competence				
-	After attending the course students are able			
	· · · · · · · · · · · · · · · · · · ·			
	 to work in a team and to persent the results of the team work 			
	 to use the feedback from other students to improve the own 			
	 to give a feedback to other students in a constructive manner 	r		
Autonomy	After attending the course students are able			
	to control and improve their knowledge with the help of weee	ekly presentations (lecture roo	om) and tests	(STUD.IP)
	• to divide the main task in different parts, to deduce the need	ed knowledge and to schedul	e the differen	t work steps
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination	Subject theoretical and practical work			
Examination duration and scale	Desing, Construction and prelimnary design in a written form			
Assignment for the	General Engineering Science (German program, 7 semester): Specia	alisation Civil Engineering: Co	mpulsory	
Following Curricula	Civil- and Environmental Engineering: Core Qualification: Compulsor			
. e.e.ting carricula	General Engineering Science (English program, 7 semester): Special	-		

rse L0209: Basics in Struc	
Тур	Project-/problem-based Learning
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Thomas Kölzer
Language	DE
Cycle	WiSe
Content	Constructing a small individuell building in groups of 4 persons
	 Analysing the informations and the contents of development plans and building regulation laws
	 Design of building components and approving of the functionality (sealing, facades, roofs)
	 Design of building components and approving of the functionancy (searing, facades, roots) Design and approve of the functionality of the component interconnections
	 Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control
	Assessing the building stability Bosics of building convisos
	Basics of building services Fach week the results of different work store are presented in and written form
	Each week the results of different work steps are presented in oral and written form
Literature	Vortragsfolien der Lehrveranstaltung stehen über STUD. IP zum download zur Verfügung
	Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich)
	Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource]
	ISBN: 978-3-8351-9121-1
	Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006
	Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.)
	Baukonstruktionslehre 2 / [Internet-Ressource]
	ISBN: 978-3-8348-9486-1
	Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
	Dierks, Klaus (Wormuth, Rüdiger.)
	Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer,
	Fenster, Türen, Konstruktionsatlas]
	ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4
	Neuwied : Werner, 2007
	Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus)
	Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROM: Stabwerksprogramm IQ 100 B, Tools für
	den konstr. Ingenieurbau, Fachinformationen, Normentexte]
	ISBN: 3804152287
	Neuwied : Werner, 2006
	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, Raumbedarf, Raumbeziehungen, Maße fü
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn
	Lehrenden und Lernenden
	ISBN: 978-3-8348-0732-8 (GB.)
	Wiesbaden : Vieweg + Teubner, 2009

Course L0205: Basics of Stru	ctural Design
Hrs/wk	
CP	
	Independent Study Time 2, Study Time in Lecture 28
	Thomas Kölzer
Language	
Cycle	WiSe
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
Elerature	
	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
	Wondoherst Deinhard (Wetzell O. W., Poumgastor, H.)
	Wendehorst, Reinhard (Wetzell, O. W.,; Baumgartner, H.,) Wendehorst Bautechnische Zahlentafeln
	ISBN: 978-3-8351-0055-8
	Stuttgart/Berlin: Teubner/Beuth, 2018

Course L0208: Basics in Stru	ctural Design
	Recitation Section (large)
Hrs/wk	
CP	
	- Independent Study Time 16, Study Time in Lecture 14
	Thomas Kölzer
Language	
Cycle	
Content	WIDE
content	Constructing a small individuell building in groups of 4 persons
	 Analysing the informations and the contents of development plans and building regulation laws
	 Design of building components and approving of the funcionality (sealing, facades, roofs)
	 Design and approve of the functionality of the component interconnections
	 Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control
	Assessing the building stability
	Basics of building services
	Each week the results of different work steps are presented in oral and written form
Literature	Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung
	Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich)
	Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource]
	ISBN: 978-3-8351-9121-1
	Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006
	Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.)
	Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1
	Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
	Dierks, Klaus (Wormuth, Rüdiger.)
	Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer,
	Fenster, Türen, Konstruktionsatlas]
	ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4
	Neuwied : Werner, 2007
	Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus)
	Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROM: Stabwerksprogramm IQ 100 B, Tools für
	den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287
	Neuwied : Werner, 2006
	Neumeu - Wenner, 2000
	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, Raumbedarf, Raumbeziehungen, Maße für
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn,
	Lehrenden und Lernenden
	ISBN: 978-3-8348-0732-8 (GB.) Wischaden : Vieweg + Taubaar 2009
	Wiesbaden : Vieweg + Teubner, 2009

Module M0755: Geote	shnice II				
Module M0755: Geote					
Courses					
Гitle			Тур	Hrs/wk	СР
oundation Engineering (L0552)			Lecture	2	2
oundation Engineering (L0553)			Recitation Section (large)	2	2
oundation Engineering (L1494)			Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous	Modules:				
Knowledge					
	Mechanics I-II				
	 Geotechnics I 				
Educational Objectives	After taking part successfully, s	udents have reached the follow	ving learning results		
Professional Competence					
Knowledge	The students know the basic pri	ciples and methods which are	required to verificate the stab	ility of geotechni	cal structures.
Skills	cills After successful completion of the module the students are able to:				
	 verificate the stability an 	usability of foundations			
	-	of ground improvement and ap	nly thom in their range of ann	lication	
	 design retaining walls. 	n ground improvement and ap	pry them in their range of app	lication,	
	• design retaining wans.				
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 96, Stu	dy Time in Lecture 84			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 20 % Attestati	n			
Examination	Written exam				
Examination duration and	60 minutes				
scale					
Assignment for the	General Engineering Science (G	rman program, 7 semester): S	pecialisation Civil Engineering	: Elective Compul	sory
Following Curricula	General Engineering Science (G	rman program, 7 semester): S	pecialisation Civil Engineering	: Elective Compul	sory
	Civil- and Environmental Engine	ring: Specialisation Civil Engine	eering: Compulsory		
	Civil- and Environmental Engine	ering: Specialisation Traffic and	Mobility: Elective Compulsory	,	
	Civil- and Environmental Engine	ering: Specialisation Water and	Environment: Elective Compu	lsory	
	Civil- and Environmental Engine	ering: Core Qualification: Comp	ulsory		
	General Engineering Science (E	glish program, 7 semester): Sp	ecialisation Civil Engineering:	Elective Compuls	sory
	Technomathematics: Specialisa	on III. Engineering Science: Ele	ective Compulsory		

Course L0552: Foundation E	ngineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe/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

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

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

Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L0321)			Lecture	3	4
Computer Engineering (L0324)			Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous	Basic knowledge in electrical eng	ineering			
Knowledge					
	After taking part successfully, st	Idents have reached the follo	wing learning results		
Professional Competence	This module deals with the form	detions of the functionality	of computing systems. It can	ava tha lawara from	
Knowledge	This module deals with the four programming down to gates. The	-			T the assembly-le
	Introduction				
			unctions, hardware synthesis,	combinational netv	vorks
	Technological foundations	, automata, systematic hardw	vare design		
		ger addition, subtraction, mul	tiplication and division		
			MIPS single-cycle architecture	e, pipelining	
	Memories: Memory hierary	chies, SRAM, DRAM, caches			
	Input/output: I/O from the	perspective of the CPU, princ	iples of passing data, point-to-	-point connections,	busses
Skills	The students perceive computer	systems from the architect's	perspective, i.e., they identify	the internal struct	ure and the physi
01110	composition of computer system				
	collection of few and simple con				
	today's computing systems - from	n gates and circuits up to cor	nplete processors.		
	After successful completion of t	he module, the students are	able to judge the interdeper	dencies between a	a physical compu
	system and the software execut				
	on the hardware-centric abstract				
	the impact that these low abstra	ction levels have on an entire	system's performance and to	propose feasible o	ptions.
Personal Competence					
	Students are able to solve simila	r problems alone or in a grou	n and to present the results ar	cordinaly	
Social competence	Stadents are able to solve simila	problems alone of in a group	p and to present the results at	cordingly.	
Autonomy	Students are able to acquire new	knowledge from specific lite	rature and to associate this kn	owledge with other	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Course achievement	Compulsory Bonus Form	Description			
	Yes 10 % Excercise	5			
	Written exam				
	90 minutes, contents of course a	nd labs			
scale Assignment for the	General Engineering Science (Ge	rman program 7 comostor);	Specialization Computer Scien	co: Compulsory	
Following Curricula					rv
· · · · · · · · · · · · · · · · · · ·	General Engineering Science (Ge				.,
		rman program, 7 semester):	Specialisation Electrical Engine	eering: Compulsory	,
	General Engineering Science (Ge	rman program, 7 semester):	Consideration Disposition Engl	incoring, Compulso	
	General Engineering Science (Ge		Specialisation Biomedical Eng	meening. Compuiso	
		rman program, 7 semester):		e .	ry
	General Engineering Science (Ge		Specialisation Energy and Env	iromental Engineer	ry
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1 1	Consel Engineering Colored (English angular). Conselection Engineering and Engineering Computers
	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 Eng	jineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 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	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title		Тур		Hrs/wk	СР
Wastewater Disposal (L0276)		Lecture		2	2
Wastewater Disposal (L0278)		Recitation Sec	tion (large)	1	1
Drinking Water Supply (L0306)		Lecture		2	1
Drinking Water Supply (L0308)		Recitation Sec	tion (large)	1	2
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
Recommended Previous	De sie besonde das ein Chassister and	B island			
Knowledge	Basic knowledge on Chemistry and				
	 Hydraulics of pipe systems and operation 	en channels			
	 Basic knowledge on water manage 	ment: water quantity and water quali	ty		
	 Basic knowledge on Environmental 	Legislation: Federal Water Act			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning re-	sults		
Professional Competence	······	······································			
	The students can examplify their expert	knowledge on urban water infrastruc	tures. They can	present the de	rivation and detai
	explanation of important standards for th				
					-
	are capable of reproducing the relevant e				
	discuss sanitary engineering processes a				
	existing problems in the field of sanitary	engineering by considering legal, risk	and saftey aspe	ects. Furthermo	re, they know how
	draft the features and effectiveness of in	nportant technologies of the future	such as high- ar	nd low-pressure	membrane filtrat
	systems and techniques for the removal of	of trace pollutants.			
Skills	The students are able to apply the releva	ant standards and guidelines for the	design and oper	ration of urban	water infrastructu
	independently. Their expertise comprises				
	associated treatment facilities. Besides th				
	problems in the filed of drinking water a		ants are also ad	ble to develop i	deas of their owr
	improve the existing water related infrast	ructures, systems and concepts.			
Personal Competence					
Social Competence	Social skills are not targeted in this modu	le.			
Autonomy	Students are able to form concepts on t	heir own to optimize urban water ir	frastructure pro	cesses. Therefo	ore they can acqu
-	appropriate knowledge when being giver				
	follow-up of the exercises).		Jana to the app		(preparation (
	follow-up of the exercises).				
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Civ	/il Engineering: F	Elective Compul	sory
Following Curricula	General Engineering Science (German pro	ogram, 7 semester): Specialisation Gr	een Technologie	es: Compulsory	
	Civil- and Environmental Engineering: Cor	e Qualification: Compulsory			
	Civil- and Environmental Engineering: Cor	e Qualification: Compulsory			
	General Engineering Science (English pro				

Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	DE
Cycle	SoSe
Content	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, Membra 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: völlig neu bearb. Aufl.). Renningen: expert-Verl.
	 Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Educat 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: 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

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

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

Module M0869: Hydra	ulic Engineering					
Courses						
Title				Тур	Hrs/wk	СР
lydraulics (L0957)				Lecture	1	1
Hydraulics (L0958)				Project-/problem-based Learning	1	1
Hydraulic Engineering (L0959)				Lecture	2	2
Hydraulic Engineering (L0960)				Project-/problem-based Learning	1	2
	Prof. Peter Fröhle					
Admission Requirements	Vone					
Recommended Previous	Hydraulic Engineering I					
Knowledge	if a route frighteening i					
Educational Objectives	After taking part successfully, stud	lonts have r	achod the followin	a loarning results		
-	Alter taking part successionly, stud	ients nave n	eached the followin			
Professional Competence						
Knowledge	Students are able to define the b					
	basic hydrodynamic formulations					
	llustrate important tasks of hydra	ulic enginee	ring and give an o	verview over river engineering,	flood protect	ion, hydraulic pov
	engineering and waterways engine	eering.				
Skills	The students are able to apply hy	draulic ongi	pooring mothods a	nd approaches to basic practice	al problems a	nd dosign rosport
SKIIIS						
	hydraulic engineering systems. Be		-			
	water surfaces of channel flows, ir				as now condi	tions of pipe syste
	Furthermore, they are able to run,	explain and	document basic h	ydraulic experiments.		
Personal Competence						
	The students are able to deploy t	heir gained	knowledge in appl	ied problems Additionaly they	will be able t	o work in team w
Social competence	engineers of other disciplines in	-				
	approaches.	a gour-orien	tatea, structurea	manner. mey can explain the	r results by t	use of peer learning
4.460.00.000		and another as the	and their line wile de	e and apply it to now problems		they are conchin
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems. Furthermore, they are capable of					
	organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge.					
Workload in Hours	ndependent Study Time 110, Stud	ay Time in Le	ecture 70			
Credit points	ວິ Compulsory Bonus Form		Description			
Course achievement		heoretical	andDurchführung	, Dokumentation und Präs	sentation zu	einem Versuo
	practical w		-	ik oder Hydraulik		versue
Examination	Written exam	UIK	nyaromeenan			
	The duration of the examination	is 2 hours	The examination i	ncludes tasks with respect to	the general i	inderstanding of t
scale	ecture contents and calculations			ficiales tasks with respect to	the general t	inderstanding of t
Assignment for the	General Engineering Science (Gen		7 comostor): Spo	cialization Civil Engineering: Ele	octivo Compul	5071
Following Curricula	General Engineering Science (Ger				-	-
Following Curricula		man progran	n, 7 semester): Sp	ectalisation Green Technologies	, FOCUS Wale	and Environment
	Engineering: Elective Compulsory					
	Civil- and Environmental Engineer	5				
	General Engineering Science (Eng				ctive Compuls	ory
	Green Technologies: Energy, Wate	er, Climate: S	pecialisation Wate	r: Elective Compulsory		
Course L0957: Hydraulics						
Тур	Lecture					
Hrs/wk	1					
CP	1					
Workload in Hours	ndependent Study Time 16, Study	/ Time in Leo	ture 14			
Lecturer	Prof. Peter Fröhle					
	DE					
Cycle	WiSe/SoSe					
Content	low of incompressible fluids in pi	pes and oper	n channels			
	Hydraulics of pipes					

- Hydraulics of pipes Punps in hydraulic systems
- Open channel flow
- Regulative construction in open channel flow • Weirs
 - Sliding panels
 - Cross-section reduction by constructions

Literature	Zanke, Ulrich C. , Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-
	Verlag, 2003
	Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992

Course L0958: Hydraulics	
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/SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0959: Hydraulic Eng	ineering
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe/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: Hydraulic Eng	ourse L0960: Hydraulic Engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. 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.

Module M0886: Funda	amentals of Process Engineering	and Material Engineering		
Courses				
Title Introduction into Process Engineeri Fundamentals of material engineer		Typ Lecture Lecture	Hrs/wk 2 2	CP 1 2
Module Responsible				
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
-	After passing this module the students have the	ability to		
	 give an overview of the most important fi explain some working methods for different 	elds on process and bioprocess enginee	ring,	
Skills	After passing this module the students should h list and outline the most important fields name the most important working approa read and prepare an engineering drawing explain the most important technologies scheme typical chemical and biotechnolo 	of process engineering, iches or methods of the different fields o I, for wastewater and exhaust air treatme	nt	
Personal Competence Social Competence	The students are able to work out results in groups and document provide appropriate feedback and handle 		nstructively.	
Autonomy	The students are able to estimate their progre Engineering and Bioprocess Engineering.	ss of learning by themselves and to de	liberate their lack of k	nowledge in Process
Workload in Hours	Independent Study Time 34, Study Time in Lect	ure 56		
Credit points	3			
Course achievement	Compulsory Bonus Form	Description		
	Yes 5 % Written elaboration			
	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program,			
Following Curricula	General Engineering Science (German program,		Engineering: Compulso	ry
	Bioprocess Engineering: Core Qualification: Com		incering Committee	
	General Engineering Science (English program,			
	General Engineering Science (English program, Orientierungsstudium: Core Qualification: Election		ingineering: Compulsor	у
	Process Engineering: Core Qualification: Computer			
1		,		

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

Course L0830: Fundamentals	s of material engineering			
Тур	Lecture			
Hrs/wk	2			
CP				
Workload in Hours	Jependent 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. 			

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives		ollowing learning results		
Professional Competence Knowledge		ity of computing systems. It cover	s the lavers from	the accomply-ley
Knowledge	programming down to gates. The module includes the follo		s the layers non	T the assembly-les
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boolean Comparison of the flow of the sector o		mbinational net	works
	 Sequential logic: Flip-flops, automata, systematic ha Technological foundations 	ardware design		
	Computer arithmetic: Integer addition, subtraction,	multiplication and division		
	 Basics of computer architecture: Programming mod 		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, cache			
	• Input/output: I/O from the perspective of the CPU, p	rinciples of passing data, point-to-p	oint connections,	busses
Skills	The students perceive computer systems from the archite	ct's perspective i.e. they identify t	he internal struct	ure and the physic
Skiis	composition of computer systems. The students can analy			
	collection of few and simple components. They are able to			
	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 interdepend	oncies hetween	a physical compu
	system and the software executed on it. In particular, the			
	on the hardware-centric abstraction layers from the asser			
	the impact that these low abstraction levels have on an er			
Deveral Commetence				
Personal Competence	Students are able to solve similar problems alone or in a g	roup and to present the results acco	ordinaly	
Social competence	Students are able to solve similar problems alone of in a g	roup and to present the results action	brunigiy.	
Autonomy	Students are able to acquire new knowledge from specific	literature and to associate this know	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement		ion		
	Yes 10 % Excercises			
	Written exam			
	90 minutes, contents of course and labs			
scale			Consultant	
Assignment for the Following Curricula				IIIIIIIIIIIII
Following curricula	General Engineering Science (German program, 7 semeste			n y
	General Engineering Science (German program, 7 semeste			
	General Engineering Science (German program, 7 semeste			/
	General Engineering Science (German program, 7 semeste	er): Specialisation Biomedical Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 semeste	er): Specialisation Energy and Enviro	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 semeste	er): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (German program, 7 ser	mester): Specialisation Mechanica	l Engineering, l	ocus Mechatroni
	Compulsory			
	General Engineering Science (German program, 7 ser Compulsory	nester): Specialisation Mechanical	Engineering, F	ocus Biomechani
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical I	Engineering, Foo	us Aircraft Syste
	Engineering: Compulsory	emester): Specialisation Mechanic	al Engineering	Focus Materials
		mester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering: Compulsory General Engineering Science (German program, 7 se			
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechani
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory	er): Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechani
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani roduct Developmo
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory General Engineering Science (German program, 7 semest and Production: Compulsory General Engineering Science (German program, 7 semest	er): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani roduct Developme
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory General Engineering Science (German program, 7 semest and Production: Compulsory General Engineering Science (German program, 7 semest Compulsory	er): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani roduct Developme
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory General Engineering Science (German program, 7 semest and Production: Compulsory General Engineering Science (German program, 7 seme Compulsory Computer Science: Core Qualification: Compulsory	er): Specialisation Mechanical Engir ter): Specialisation Mechanical Engi ester): Specialisation Mechanical E	neering, Focus Th neering, Focus F Engineering, Foc	eoretical Mechani roduct Developme
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semest Engineering: Compulsory General Engineering Science (German program, 7 semest and Production: Compulsory General Engineering Science (German program, 7 seme Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory	er): Specialisation Mechanical Engir ter): Specialisation Mechanical Engi ester): Specialisation Mechanical E r): Specialisation Computer Science	neering, Focus Th neering, Focus F Engineering, Foc	eoretical Mechani roduct Developm us Energy Syster
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semeste Engineering: Compulsory General Engineering Science (German program, 7 semeste and Production: Compulsory General Engineering Science (German program, 7 semeste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engir er): Specialisation Mechanical Engi ester): Specialisation Mechanical E r): Specialisation Computer Science r): Specialisation Bioprocess Engine	eering, Focus Th neering, Focus F Engineering, Foc : Compulsory ering: Compulsor	eoretical Mechani roduct Developm us Energy Syster
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semeste Engineering: Compulsory General Engineering Science (German program, 7 semeste and Production: Compulsory General Engineering Science (German program, 7 semeste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering: Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engin er): Specialisation Mechanical Engin ester): Specialisation Mechanical Engine r): Specialisation Computer Science r): Specialisation Bioprocess Engine r): Specialisation Naval Architecture r): Specialisation Civil Engineering:	eering, Focus Th neering, Focus F Engineering, Foc : Compulsory ering: Compulsory Compulsory	eoretical Mechani roduct Developm us Energy Syster Y
	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 semeste Engineering: Compulsory General Engineering Science (German program, 7 semeste and Production: Compulsory General Engineering Science (German program, 7 semeste Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical Engin er): Specialisation Mechanical Engin ester): Specialisation Mechanical Enginer r): Specialisation Computer Science r): Specialisation Bioprocess Engine r): Specialisation Naval Architecture r): Specialisation Civil Engineering: r): Specialisation Electrical Engineer	eering, Focus Th neering, Focus F Engineering, Foc : Compulsory ering: Compulsory Compulsory ing: Compulsory ing: Compulsory	eoretical Mechani rroduct Developme us Energy System Y

	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
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
5	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
ā	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
	Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
r	Mechatronics: Core Qualification: Compulsory
۲ ا	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Engineering		
Тур	ecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	 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
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title Fundamentals of Fluid Mechanics (I Fluid Mechanics for Process Engine		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 4 2
Module Responsible				_
Admission Requirements	None			
Recommended Previous				
Knowledge	Mathematics I+II+III Taskniss Mashanias I+II			
	Technical Mechanics I+II Technical Thermodynamics I+II			
	Working with force balances			
	 Simplification and solving of partial differentiation 	al equations		
	Integration			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence	Alter taking part successiony, students have reache			
-	Students are able to:			
	explain the difference between different type			
	 give an overview for different applications of explain simplifications of the Continuity- and 			ions
	• explain simplifications of the continuity- and	Navier-Stokes-Equation by using physical	boundary condit	10113
Skills	The students are able to			
	 describe and model incompressible flows mat 	hematically		
	 reduce the governing equations of fluid mech 	anics by simplifications to archive quanti	tative solutions e	.g. by integration
	 notice the dependency between theory and to 	echnical applications		
	 use the learned basics for fluid dynamical apprendiction 	plications in fields of process engineering		
Personal Competence				
Social Competence	The students			
	 are capable to gather information from subje 	ct related professional publications and	relate that inform	nation to the conte
	of the lecture and			
	 able to work together on subject related task 	ks in small groups. They are able to pres	ent their results	effectively in Engli
	(e.g. during small group exercises)			
	 are able to work out solutions for exercises by 	r themselves, to discuss the solutions ora	Illy and to presen	t the results.
Autonomy	The students are able to			
	 search further literature for each topic and to 	expand their knowledge with this literati	Ire	
	 work on their exercises by their own and to exercise 			
		-		
	Independent Study Time 124, Study Time in Lecture	56		
Credit points Course achievement		Description		
course acmevement	Yes 5 % Midterm			
Examination	Written exam			
Examination duration and	3 hours			
scale				
Assignment for the				
Following Curricula	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 so Bioprocess Engineering: Core Qualification: Compute		omentai Enginee	ing: compulsory
	Energy and Environmental Engineering: Core Qualifi	•		
	General Engineering Science (English program, 7 se		ng: Compulsory	
	General Engineering Science (English program, 7 se			ry
	General Engineering Science (English program, 7 se			
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory		
	Process Engineering: Core Qualification: Compulsory	,		

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
CP	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, 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

Course L0092: Fluid Mechani	cs for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 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

Courses				
Title		Тур	Hrs/wk	СР
Biochemistry (L0351)		Lecture	2	2
Biochemistry (L0728)		Project-/problem-based Learning	1	1
Microbiology (L0881)		Lecture	2	2
Microbiology (L0888)		Project-/problem-based Learning	1	1
Module Responsible	Dr. Paul Bubenheim			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	At the end of this module the students can:			
			-le sule -	
	 explain the methods of biological and biochemical research to 	determine the properties of biom	iolecules	
	- name the basic components of a living organism			
	- explain the principles of metabolism			
	- explain the principles of metabolism			
	- describe the structure of living cells			
Cl.:II-				
Skills				
Personal Competence				
Social Competence	The students are able,			
	- to gather knowledge in groups of about 10 students			
	 to introduce their own knowledge and to argue their view in di 	iscussions in teams		
	- to divide a complex task into subtasks, solve these and to pre-	sent the combined results		
4.4				
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 Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
	General Engineering Science (German program, 7 semester): S	pecialisation Bioprocess Engineer	na: Compulso	rv.
-	Bioprocess Engineering: Core Qualification: Compulsory	Engineer		3
	General Engineering Science (English program, 7 semester): Sp	ecialisation Bioprocess Engineering	na: Compulson	V
	Orientierungsstudium: Core Qualification: Elective Compulsory	Second Bioprocess Engineerin	.g. compaisor	1
	chemical angestadiant. core quanteation. Elective compulsory			

Course L0351: Biochemistry	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	 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 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: Biochemistry	
Тур	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Paul Bubenheim
Language	DE
Cycle	SoSe
Content	
	1. The molecular logic of Life
	2. Biomolecules:
	1. Amino acids, peptides, proteins
	2. Carbohydrates
	3. Lipids
	3. Protein functions, Enzymes:
	1. Michaelis-Menten kinetics
	2. Enzyme regulation
	3. Enzyme nomenclature
	4. Cofactors and cosubstrates, vitamines
	5. Metabolism:
	1. Basic principles
	2. Photosynthesis
	3. Glycolysis
	4. Citric acid cycle
	5. Respiration
	6. Anaerobic respirations
	7. Fatty acid metabolism
	8. 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 L0881: Microbiology	
	Lecture
Тур	
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Christian Schäfers
Language	
Cycle	
Content	1. The procaryotic cell
	evolution
	 taxonomy and specific properties of Archaea, Bacteria, and viruses
	 structure and properties of the cell
	• growth
	2. Metabolism
	fermentation and anaerobic respiration
	methanogenesis and the anaerobic food chain
	degradation of polymers
	chemolithotrophy
	3. Microorganisms in relation to the environment
	chemotaxis and motility
	Elemental cycle of carbon, nitrogen and sulfur
	biofilms
	symbiotic relationships
	extremophiles
	biotechnology
Literature	
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/

Course L0888: Microbiology	
Тур	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Christian Schäfers
Language	DE
Cycle	SoSe
Content	 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
Literature	 biotechnology 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/

Courses				
Title		Тур	Hrs/wk	СР
Phase Equilibria Thermodynamics (Lecture	2	2
Phase Equilibria Thermodynamics (Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (Recitation Section (large)	1	Z
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics, Physical Chemistry, Thermo	agynamics I and II		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge Skills	 equilibria. They learn how state variables and these properties. Moreover, the students learn how different phases (vapor, liquid, solition) For different phase equilibria, sew knowledge for plotting and interpresent the state and know how to simplify the state and know how to simplify the the students know models which the are able to solve the resulting mattine. For specific applications, they are 	dents are able to identify the correct equation for se equations meaningfully. can be used to determine the properties of the sys hematical relations. able to self-reliantly find necessary physico-chemic	rn concepts to qu v and which pherent ntals of reaction of cesses are show the determination the determination the min the equili	uantitatively descr nomena may occu equilibria are taugi n and the necess on of the equilibri brium state and th
	The students know how to visualize	the students are capable of describing the propertie e phase equilibria graphically and they know how to students are able to understand fundamental co	interpret the occ	
Personal Competence Social Competence	The students are able to work in small g other students	roups, to solve the corresponding problems and to	present them o	aly to the tutors a
Autonomy	The students are able to find neces	ssary information self-reliantly in literature sources s are able to check their learning progress cont their learning process.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement				
Examination	Written exam			
	120 minutes; theoretical questions and ca	alculations		
Assignment for the Following Curricula	General Engineering Science (German pro Bioprocess Engineering: Core Qualificatio	ogram, 7 semester): Specialisation Process Enginee ogram, 7 semester): Specialisation Bioprocess Engir n: Compulsory gram, 7 semester): Specialisation Process Engineer	neering: Compuls	
		gram, 7 semester): Specialisation Bioprocess Engin		ry

ırse L0114: Phase Equilib	ria Thermodynamics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	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. 3 rd ed. Prentice Hall, 1997, J.P. O'Connell, J.M. Haile Thermodynamics. Cambridge University Press, 2005.

Course L0140: Phase Equilib	ria Thermodynamics
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	 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 The students work on tasks in small groups and present their results in front of all students.
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 Equilib	ria Thermodynamics
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	 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: eaction 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				
		.	Have foods	65
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4
Signals and Systems (L0433)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge				
	The modul is an introduction to the theory of signals and			
	1-3 is expected. Further experience with spectral trans but not required.	ormations (rouner series, rouner th	апѕюпп, саріасе	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals a	nd linear time-invariant (LTI) systems	using methods	of signal and syste
	theory. They are able to apply the fundamental transfo		-	-
	can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particu			
	understand the effects in time domain and image don	ain which are caused by the transi	tion of a continu	ous-time signal to
Skille	discrete-time signal. The students are able to describe and analyse determin	ctic cignals and linear time invariant	avetome using m	othods of signal a
<i>SKIIIS</i>	system theory. They can analyse and design basic s	-		-
	response, stability, linearity etc They can assess the im			
Personal Competence		, , , ,		,
	The students can jointly solve specific problems.			
	The students are able to acquire relevant information	n from appropriate literature sour	ces. They can c	ontrol their level
	knowledge during the lecture period by solving tutorial p			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ter): Specialisation Electrical Engine	ering: Compulsory	/
Following Curricula	General Engineering Science (German program, 7 seme	ter): Specialisation Computer Scienc	e: Compulsory	
	General Engineering Science (German program, 7 seme	ter): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory			
	General Engineering Science (German program, 7 seme	ter): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering, F	ocus Biomechanio
	Compulsory			
	General Engineering Science (German program, 7 se	nester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory	mostor), Specialization Machanical	Engineering For	un Aircraft Suctor
	General Engineering Science (German program, 7 se Engineering: Compulsory	nester). Specialisation Mechanical	Engineering, Foc	us Alfcialt Syster
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering	Focus Materials
	Engineering Sciences: Compulsory	seriestery. Specialisation meenanic	ur Engineering,	Focus Materials
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	I Engineering, I	Focus Mechatronio
	Compulsory		5 5.	
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechanio
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semes	er): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 semes	er): Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanica	Engineering, F	ocus Biomechani
	Compulsory	actor), Enocialization Machanical	Engineering For	us Enorgy System
	General Engineering Science (English program, 7 ser Compulsory	lester). Specialisation Mechanical I	ingineering, roc	us Ellergy System
	General Engineering Science (English program, 7 set	nester): Specialisation Mechanical	Engineering Foo	us Aircraft System
	Engineering: Compulsory			
	General Engineering Science (English program, 7 semes	er): Specialisation Mechanical Engine	eering, Focus Mai	terials in Engineeri
	Sciences: Compulsory		J	52011
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanica	I Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (English program, 7 seme	ter): Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Computational Science and Engineering: Core Qualificat	on: Compulsory		
	Machatranica, Cara Qualification, Compulsory			
	Mechatronics: Core Qualification: Compulsory			

Course L0432: Signals and S	ystems
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	
Lecturer	
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.
<u> </u>	<u> </u>

Course 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

6				
Courses				
Title		Тур	Hrs/wk	СР
Bioprocess Engineering - Fundamentals (L0841)		Lecture Recitation Section (large)	2	3 1
Bioprocess Engineering- Fundamentals (L0842) Bioprocess Engineering - Fundamental Practical Course (L0843)		Practical Course	2 2	2
Module Responsible			_	
Admission Requirements				
Recommended Previous	none, module "organic chemistry", module "fund	amontals for process ongingering"		
Knowledge	none, module organic chemistry , module func	amentals for process engineering		
5	After taking part successfully, students have rea	ched the following learning results		
Professional Competence	Alter taking part successiony, students have rea	ched the following learning results		
Knowledge	Students are able to describe the basic concept enzymes and microorganisms, as well as to rheology can be named and mass transport p fundamental bioprocess management, sterilizati	differentiate different types of inhibition. Torocesses in bioreactors can be explained.	The parameters of The students are	of stoichiometry a
Skills	 After successful completion of this module, stud describe different kinetic approaches for a predict qualitatively the influence of end fermentation process analyze bioprocesses on basis of stoichion distinguish between scale-up criteria for a to compare them as well as to apply them propose solutions to complicated biotechin to explore new knowledge resources and identify scientific problems with concrete to document and discuss their procedures 	growth and substrate-uptake and to calculatery generation, regeneration of redox equinetry and to set up / solve metabolic flux equing the set of the set	ivalents and grou uations robic, aerobic as	wth inhibition on
	After completion of this module participants sho take position to their own opinions and increase After completion of this module participants will workflow and to present their results in a plenu	their capacity for teamwork in engineering a be able to solve a technical problem in a to	and scientific envi	ronments.
Workload in Hours	Independent Study Time 96 Study Time in Lect	10.94		
Credit points	Independent Study Time 96, Study Time in Lecto			
Course achievement	O Compulsory Bonus Form	Description		
evalue achieventent		and		
	practical work			
Examination	Written exam			
Examination duration and scale	90 min			
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Process Enginee	ring: Compulsory	
Following Curricula	General Engineering Science (German program,	7 semester): Specialisation Bioprocess Engi	neering: Compulso	bry
	Bioprocess Engineering: Core Qualification: Com	pulsory		
	General Engineering Science (English program,		5 1 5	
	General Engineering Science (English program,			ry
	Biomedical Engineering: Specialisation Artificial		sory	
	Biomedical Engineering: Specialisation Implants			
	Biomedical Engineering: Specialisation Medical T			
	Biomedical Engineering: Specialisation Managen		ompulsory	
	Technomathematics: Specialisation III. Engineeri			
	Process Engineering: Core Qualification: Compul	sory		

Course L0841: Bioprocess En	igineering - Fundamentals
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	 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

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

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

Courses				
Title	Typ Hrs/wł	k CF	D	
Heat and Mass Transfer (L0101)	Lecture 2	к СР 2	F	
Heat and Mass Transfer (L0102)	Recitation Section (small) 1	2		
Heat and Mass Transfer (L1868)	Recitation Section (large) 1	2		
Module Responsible	le Prof. Irina Smirnova			
Admission Requirements				
-	Is Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lawning results			
-	After taking part successfully, students have reached the following learning results			
Professional Competence Knowledge				
	 The students are capable of explaining qualitative and determining quantitative heat transfer in prheat exchanger, chemical reactors). They are capable of distinguish and characterize different kinds of heat transfer mechanisms nam transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and to qualitative and quantitative by using suitable mass transfer theories. They are able to depict the analogy between heat- and mass transfer and to describe complex link 	nely heat co to describe	nduction, h mass trans	
Skills	 The students are able to set reasonable system boundaries for a given transport problem by using the gained knowled and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in flui and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowled for the description and design of apparatus (e.g. extraction column, rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a speciapplication considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete techni problems. 			
Personal Competence Social Competence				
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 proced system, exam-like assignments) and on this basis they can control their learning processes. 	lure continu	iously (click	
Workload in Hours	rs Independent Study Time 124, Study Time in Lecture 56			
Credit points	ts 6			
Course achievement	1t None			
Examination	m Written exam	_		
Examination duration and	d 120 minutes; theoretical questions and calculations			
scale	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory			
	la General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Com	npulsory		
Assignment for the	la General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Eng		ompulsory	
Assignment for the		gineering: C	ompulsory	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Eng	gineering: C	ompulsory	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Eng General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compute	gineering: C	ompulsory	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Eng General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compute Bioprocess Engineering: Core Qualification: Compulsory	gineering: Co Isory	ompulsory	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Eng General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compuls Bioprocess Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory	gineering: Co Isory pulsory		
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Eng General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compuls Bioprocess Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Comp	gineering: Co Isory pulsory jineering: Co		
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulse Bioprocess Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Core General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compute Computer Specialisation Bioprocess Engineering: Computer Specialisation: Computer	gineering: Co Isory pulsory jineering: Co		

Course L0101: Heat and Mas	s Transfer
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 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	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

	nal Separation Processes			
Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01		Lecture	2	2
Thermal Separation Processes (L01		Recitation Section (small)	2	2
Thermal Separation Processes (L0141) Separation Processes (L1159)		Recitation Section (large) Practical Course	1 1	1 1
Module Responsible	Prof. Irina Smirnova			_
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynam	nics III		
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence		· · · · · · · · · · · · · · · · · · ·		
Knowledge	 The students can distinguish and do adsorption The students develop an understanding energy demand of a process, the possibility of the students develop and the students develop and students develop an	escribe different types of separation processes ng for the course of concentration during a sepa sibilities of energy saving, and the selection of sep ng methods for separation processes and devices	aration process, 1 paration systems	the estimation of t
Skills Personal Competence Social Competence	 close the associated energy and mate The students can use different grap theoretical stages required They can select and design a basic disadvantages of the process The students are capable to obtain in tables) They can calculate continuous and dis The students are able to prove their the The students are able to discuss the colloquium. The students are capable of linking their gait technical problems. Other lectures such as the 	hical methods for the designing of a separation type of thermal separation process for a given adependently the needed material properties from scontinuous processes neoretical knowledge in the experimental lab wor theoretical background and the content of the ex ned knowledge with the content of other lectures hermodynamics, fluid mechanics and chemical er	n process and d case based on m appropriate so k. perimental work and use it togeth gineering.	efine the amount the advantages a surces (diagrams a with the teachers her for the solution
Social Competence	 The students can work technical assignment 	nments in small groups and present the combine		utorial
		esults and to document them scientifically in a re		ion of labor betwe
Autonomy	them. They are able to discuss their rThe students are capable to obtain th		port. emselves and as	sess their quality
-	them. They are able to discuss their rThe students are capable to obtain thThe students can proof the state of	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign	port. emselves and as	sess their quality
-	 them. They are able to discuss their r The students are capable to obtain th The students can proof the state of learning process 	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign	port. emselves and as	sess their quality
Workload in Hours	 them. They are able to discuss their r The students are capable to obtain th The students can proof the state of learning process 	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign	port. emselves and as	sess their quality
Workload in Hours Credit points Course achievement Examination	them. They are able to discuss their re • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign ecture 84	port. emselves and as	sess their quality
Workload in Hours Credit points Course achievement Examination Examination duration and	 them. They are able to discuss their re The students are capable to obtain th The students can proof the state of learning process 	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign ecture 84	port. emselves and as	sess their quality
Workload in Hours Credit points Course achievement Examination Examination duration and scale	them. They are able to discuss their m The students are capable to obtain th The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign ecture 84	port. emselves and as ments and in th	sess their quality
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	them. They are able to discuss their m • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign ecture 84 	port. emselves and as ments and in th	sess their quality is way control th
Workload in Hours Credit points Course achievement Examination Examination duration and scale	them. They are able to discuss their m • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr General Engineering Science (German progr	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign ecture 84 ulations am, 7 semester): Specialisation Process Engineeri am, 7 semester): Specialisation Bioprocess Engineeri	port. emselves and as ments and in th ing: Compulsory eering: Compulsory	sess their quality is way control th
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	them. They are able to discuss their m • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr	esults and to document them scientifically in a re- e needed information from suitable sources by th their knowledge with exam resembling assign ecture 84 ulations am, 7 semester): Specialisation Process Engineer am, 7 semester): Specialisation Bioprocess Engineer am, 7 semester): Specialisation Bioprocess Engineer am, 7 semester): Specialisation Energy and Enviro	port. emselves and as ments and in th ing: Compulsory eering: Compulsory	sess their quality is way control th
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	them. They are able to discuss their re • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: C	esults and to document them scientifically in a re- e needed information from suitable sources by th t their knowledge with exam resembling assign ecture 84 ulations am, 7 semester): Specialisation Process Engineeri am, 7 semester): Specialisation Bioprocess Engineeri am, 7 semester): Specialisation Bioprocess Engineeri am, 7 semester): Specialisation Energy and Enviro Compulsory	port. emselves and as ments and in th ing: Compulsory eering: Compulsory	sess their quality is way control th
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	them. They are able to discuss their re • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: Core Energy and Environmental Engineering: Core	esults and to document them scientifically in a re- e needed information from suitable sources by th t their knowledge with exam resembling assign ecture 84 ulations am, 7 semester): Specialisation Process Engineeri am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Energy and Enviro Compulsory e Qualification: Compulsory	port. emselves and as ments and in th ing: Compulsory eering: Compulsory eomental Enginee	sess their quality is way control th
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	them. They are able to discuss their re • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: Core Energy and Environmental Engineering: Core General Engineering Science (English progra	esults and to document them scientifically in a re- e needed information from suitable sources by th t their knowledge with exam resembling assign ecture 84 ulations am, 7 semester): Specialisation Process Engineeri am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Energy and Envir Compulsory e Qualification: Compulsory m, 7 semester): Specialisation Bioprocess Engine	port. emselves and as ments and in th ing: Compulsory eering: Compulsor omental Enginee ering: Compulso	sess their quality is way control th
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	them. They are able to discuss their re • The students are capable to obtain th • The students can proof the state of learning process Independent Study Time 96, Study Time in L 6 None Written exam 120 minutes; theoretical questions and calcu General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: C Energy and Environmental Engineering: Core General Engineering Science (English progra General Engineering Science (English progra General Engineering Science (English progra	esults and to document them scientifically in a re- e needed information from suitable sources by th t their knowledge with exam resembling assign ecture 84 ulations am, 7 semester): Specialisation Process Engineeri am, 7 semester): Specialisation Bioprocess Engine am, 7 semester): Specialisation Energy and Enviro Compulsory e Qualification: Compulsory	port. emselves and as ments and in th ing: Compulsory eering: Compulsory eering: Compulso mental Engineer	sess their quality is way control th

Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Irina Smirnova
Language	
Cycle	
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	 Selection of separation processes 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 separat 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 Yor

ourse L0119: Thermal Sepa	ration Processes
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 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 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 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

L0141: Thermal Sepa
Тур
Hrs/wk
CP
Workload in Hours
Lecturer
Language
Cycle
Content
Literature

Course L1159: Separation Pr	ocesses
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
	Prof. Irina Smirnova
Language	DE/EN
Cycle	
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.
	Topics of the practical course:
	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 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

Module M0892: Chem	ical Reaction E	ngineering				
Courses						
Title				Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fu	ndamentals) (L0204)			Lecture	2	2
Chemical Reaction Engineering (Fu	ndamentals) (L0244)			Recitation Section (large)	2	2
Experimental Course Chemical Eng	ineering (Fundamentals)	(L0221)		Practical Course	2	2
Module Responsible	Prof. Raimund Horn					
Admission Requirements	None					
Recommended Previous	Contents of the previ	ous modules mathemat	ics I-III, physical c	hemistry, technical thermody	namics I+II as w	ell as computationa
Knowledge	methods for engineer	s.				
Educational Objectives	After taking part succ	essfully, students have i	reached the followi	ing learning results		
Professional Competence						
Knowledge	The students are able	to explain basic conce	pts of chemical rea	action engineering. They are	able to point out	differences betweer
	thermodynamical and	l kinetical processes. Tl	ne students have	a strong ability to outline pa	irts of isotherma	and non-isotherma
	ideal reactors and to a	describe their properties				
Skills	After successful comp	letion of the module, st	udents are able to:			
	 apply different comp 	outational methods to di	mension isotherma	al and non-isothermal ideal re	actors,	
	- determine and comp	oute stable operation po	ints for these react	tors ,		
	 conduct experiments 	s on a lab-scale pilot pla	nts and document	these according to scientific	guidelines.	
Personal Competence						
	After successful com	etition of the lab-cours	e the students ha	ve a strong ability to organiz	e themselfes in s	mall groups to solve
,				cuss their subject related kn		
	their teachers.			···· , · · · , · · · · ·		
Autonomy	The students are al	ole to obtain further i	nformation and a	assess their relevance autor	nomously. Stude	nts can apply thei
		to plan, prepare and cor				
Workload in Hours		me 96, Study Time in Le	-			
Credit points		, ,				
Course achievement	Compulsory Bonus	Form	Description			
course achievement	Yes None	Subject theoretical	and			
		practical work				
Examination	Written exam					
Examination duration and						
scale						
Assignment for the	General Engineering S	Science (German progra	m, 7 semester): Sp	ecialisation Process Engineer	ing: Compulsory	
Following Curricula				ecialisation Bioprocess Engin		ory
		ig: Core Qualification: Co			5	-
		ig: Core Qualification: Co				
		-		ecialisation Bioprocess Engine	ering: Compulso	Ŷ
				ecialisation Process Engineeri	÷ .	
		Core Qualification: Com			5	
		Core Qualification: Com	-			

Course L0204: Chemical Rea	ction Engineering (Fundamentals)
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions) Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers) Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction

mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1	species mole number, Arrhenius-
of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reac equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, ra- kinetics, analytical integration of first order differential equations - integrating factor, numerical Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reak and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, se	reactors for kinetic measurements, ctions, irreversible reaction with pre- ate limiting step, Michaelis-Menten l integration of complex kinetics) cors, discontinuous, half continuous emi-batch reactor, CSTR, Plug Flow
reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactor reactors) Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch react mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-bate	tor, integration of the batch reactor
flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reaction reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a ca interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysi	a continuously stirred tank reactor, ascade of tank reactors, numerical-
non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic te adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer th plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal rea of a reactor)	flow reactor, Levenspiel-plots, heat rough a cylindrical wall, design of a heat exchange, multiple stationary
Literature lecture notes Raimund Horn	
skript Frerich Keil	
Books:	
M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chem	ie, 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	
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 & S	ions, 2010
A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH	

Course L0244: Chemical Rea	ction Engineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE
Cycle	WiSe
Content	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

	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 is parallel and couptor flow, heat balance of the conduction flow flow reactor, and couptor flow to a 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)
1.14	
Literature	lecture notes Raimund Horn
Literature	lecture notes Raimund Horn skript Frerich Keil
Literature	
Literature	skript Frerich Keil
Literature	skript Frerich Keil Books: M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
Literature	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
Literature	skript Frerich Keil Books: M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
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Literature	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	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 H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
Literature	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	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 H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
Literature	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 H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
Literature	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 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
Literature	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 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
Literature	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 H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall O. Levenspiel, Chemical Reaction Engineering, 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
Literature	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 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

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

Courses					
		True	Line /usik	CD.	
Title Bioprocess Engineering - Advanced	1 (11107)	Typ Lecture	Hrs/wk 2	CP 4	
Bioprocess Engineering - Advanced		Recitation Section (small)	2	2	
Module Responsible	Prof. An-Ping Zeng				
Admission Requirements	None				
Recommended Previous	Content of module "Biochemical Engineering I"				
Knowledge					
Educational Objectives	After taking part successfully, students have rea	ached the following learning results			
Professional Competence					
Knowledge	After successful completion of this module, stud	lents should be able to			
	describe and explain different kinetic app	proaches for growth and substrate-uptake			
	identification of scientific problems with	concrete industrial use (cultivation of microo	rganisms and mar	nmalian cells)	
	 describe and explain important downs methods 	treaming steps for proteins and their applic	ation as well as	basic immobilizat	
Skills	After successful completion of this module, stuc	lents should be able to			
	- to identifiy scientific questions or possib	le practical problems for concrete indus	trial applications	(eq cultivation	
	microorganisms and animal cells) and to formu				
	- 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 op	timization of real biotechnological production	processes approp	riate solutions ,	
	- To describe the effects of the energy genera behavior of microorganisms and to the total fer		nts , and the gro	wth inhibition of t	
	 Establish material flow balance equations an calculate immobilization and activity yields , 	d solve them to determine the kinetic parar	neters of differen	t approaches and	
	- to select process control strategies (batch , fee	d-batch , continuity) appropriately and to ca	lculate basic type	s and evaluate the	
Personal Competence					
Social Competence	After completion of this module participants should be able to debate technical questions in small teams to enhance the abilit take position to their own opinions and increase their capacity for teamwork.				
Autonomy	After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previous unknown issues and to present these.				
Workload in Hours	Independent Study Time 124, Study Time in Lea	cture 56			
Credit points					
Course achievement					
Examination					
Examination duration and scale	90 min				
	General Engineering Science (German program	7 semester): Specialisation Rioprocess Engin	eering: Compulse	irv	
	Bioprocess Engineering: Core Qualification: Con		compulse		
. eening carricula	General Engineering Science (English program,		eering: Compulso	-y	
	Technomathematics: Specialisation III. Engineer		5 1 1 1 1 1 1 1	-	

Course L1107: Bioprocess En	igineering - Advanced
Тур	Lecture
Hrs/wk	2
CP	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

Course L1108: Bioprocess Er	ngineering - Advanced
Тур	Recitation Section (small)
Hrs/wk	2
CP	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 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) The students present exercises and discuss them with their fellow students and faculty statt. In the PBL part of the class the students discuss scientific questions in teams. They acquire knowledge and apply it to unknown questions, present their results and argue their opinions.
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

Courses					
Title			Тур	Hrs/wk	CP
Practical Exercise Environmental Te	echnology (L1387)		Practical Course	1	1
Environmental Technologie (L0326)		Lecture	2	2
Module Responsible	Prof. Martin Kaltschmitt				
Admission Requirements	None				
Recommended Previous	Fundamentals of inorganic/or	rganic chemistry	and biology		
Knowledge					
Educational Objectives	After taking part successfully	, students have r	reached the following learning results		
Professional Competence					
Knowledge	With the completion of this m	nodul the student	ts obtain profound knowledge of environme	ental technology. They	are able to descri
	the behaviour of chemicals i	n the environme	nt. Students can give an overview of scier	tific disciplines involv	ed. They can expla
	terms and allocate them to re	elated methods.			
CI:!!!-	Chudente ere eble te more		energy and mikinghing magnetic for	an deserve saket ar-bl	They are able
SKIIIS			anagement and mitigation measures for		,
			ssess the potential of pollutants to migrat		
			conmental Technology contributes to susta	inable development, a	ind they can pres
	and defend these opinons in	front of and again	nst the group.		
Personal Competence					
Social Competence	The students are able to disc	uss the various t	echnical and scientific tasks, both subject-	specific and multidisci	plinary. They are a
	to develop different approach	hes to the task as	s a group as well as to discuss their theore	tical or practical imple	mentation.
Autonomy	Students can independently (exploit sources a	bout of the subject, acquire the particular l	knowledge and tranfer	it to new problem
Workload in Hours	Independent Study Time 48,	Study Time in Le	ecture 42		
Credit points	3				
Course achievement	Compulsory Bonus Form		Description		
		ct theoretical	and		
	practi	ical work			
Examination	Written exam				
Examination duration and	1 hour				
scale					
Assignment for the	General Engineering Science	(German program	m, 7 semester): Specialisation Energy and	Enviromental Enginee	ring: Compulsory
Following Curricula	General Engineering Science	(German program	m, 7 semester): Specialisation Bioprocess I	Engineering: Elective C	Compulsory
	General Engineering Science	(German program	m, 7 semester): Specialisation Process Eng	ineering: Elective Com	pulsory
	Bioprocess Engineering: Core	e Qualification: El	ective Compulsory		
	Enorgy and Environmental E	naineering: Core	Qualification: Compulsory		
	Lifergy and Lifvironmental Li	ngineering. core	Qualification. Compaisory		
			n, 7 semester): Specialisation Bioprocess E	ngineering: Elective C	ompulsory
	General Engineering Science	(English program			
	General Engineering Science General Engineering Science	(English program (English program	n, 7 semester): Specialisation Bioprocess E	Enviromental Engineer	ing: Compulsory

Course L1387: Practical Exe	rcise Environmental Technology
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
	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: Environmenta	il Technologie
Тур	Lecture
Hrs/wk	2
CP	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
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Courses					
Title			Тур	Hrs/wk	СР
Process and Plant Engineering I (LC			Lecture	2	2
Process and Plant Engineering I (LC Process and Plant Engineering I (L1			Recitation Section (large) Recitation Section (small)	1	2
Module Responsible		4	Recitation Section (Smail)	1	Z
Admission Requirements		4			
Recommended Previous		nal an dmechanical separation	processes		
Knowledge					
	chemical reactor eingi	ineering			
Educational Objectives	After taking part succe	essfully, students have reached	the following learning results		
Professional Competence					
Knowledge	students can:				
		hished below as a muchicute of the			
	classify and formulate	blobal balance equations of ch	emical processes		
	specify linear compon	ent equations of complex chem	ical processes		
	explain linear regression and data reconcilliation problems				
	explain pfd-diagrams				
Skills	students are capable of				
	- formulation of mass and energy balance equations and estimation of product streams				
	- estimation of component streams of chemical plants using linear component balance models				
	- solution of data reco	ncilliation tasks			
	- conduction of proces	s synthesis			
	- economic evaluation of processes and the estimation of production costs				
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Tir	me 124, Study Time in Lecture	56		
Credit points	6				
Course achievement	Compulsory Bonus		escription		
	Yes 10 %	Subject theoretical and			
		practical work			
	Written exam				
Examination duration and scale	120 Min. lectures note	es and books			
	Concerci Engineering C		nortex), Cresiclination Process Engineer	ing. Computer	
			nester): Specialisation Process Engineer nester): Specialisation Bioprocess Engin		
Following curricula					
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Electiv Compulsory				
		g: Core Qualification: Compulso	rv		
			nester): Specialisation Bioprocess Engine	erina: Compulso	rv
			semester): Specialisation Energy and		
	Compulsory				J
		Science (English program, 7 sen	nester): Specialisation Process Engineeri	ng: Compulsorv	
		Core Qualification: Compulsory	. 5		

Course L0095: Process and P	Plant Engineering I	
Тур	Lecture	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mirko Skiborowski	
Language	DE	
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
	3. Process Synthesis Decision levels
	Experimental process development
	Reactor synthesis
	Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams)
	4. Process safety
	5. Cost estimation of production plants
	Production costs, capital costs, economic evaluation
Literature	
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
	H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74
	Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157
	E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997
	M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916
	R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte,
	Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004
	J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988
	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
	G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306
	G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
	S. Meier, G. Kaibel, ChemIngTech. 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
l	1

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

			Тур	Hrs/wk	СР
			Lecture	2	3
			Recitation Section (small)	1	1
			Practical Course	2	2
Prof. Stefan Heinrich					
None					
keine					
After taking part suc	cessfully, students have	e reached the followin	g learning results		
After successful com	pletion of the module s	students are able to			
	late and set				
 characterize p 	articles, particle distrib	outions and to discuss	their bulk properties		
Students are able to					
choose and design apparatuses and processes for solids processing according to the desired solids properties of the produc					
	-				
The students are ab	le to discuss scientific	topics orally with ot	her students or scientific p	ersonal and to o	levelop solutions f
technical-scientific is	sues in a group.				
Students are able to	analyze and solve que	stions regarding solid	particles independently.		
Independent Study T	ime 110, Study Time ir	1 Lecture 70			
6					
Compulsory Bonus	Form	Description			
Yes None	Written elaboration	sechs Berichte	e (pro Versuch ein Bericht) à	5-10 Seiten	
Written exam					
90 minutes					
General Engineering	Science (German prog	ram, 7 semester): Spe	cialisation Process Engineer	ing: Compulsory	
General Engineering	Science (German prog	ram, 7 semester): Spe	cialisation Bioprocess Engine	eering: Compulso	ry
General Engineering	Science (German prog	ram, 7 semester): Spe	cialisation Energy and Envir	omental Enginee	ring: Compulsory
Bioprocess Engineeri	ng: Core Qualification:	Compulsory			
	-		ulsory		
				ering: Compulso	y
					-
					,
				_ ,,	
	None keine After taking part succ After successful com • name and exp • characterize p Students are able to • choose and de • asses solids w • document the The students are able to independent Study T 5 Compulsory Bonus Yes None Written exam 90 minutes General Engineering General Engineering	After taking part successfully, students hav After taking part successfully, students hav After successful completion of the module s • name and explain processes and un • characterize particles, particle distrit Students are able to • choose and design apparatuses and • asses solids with respect to their beh • document their work scientifically. The students are able to discuss scientific technical-scientific issues in a group. Students are able to analyze and solve que independent Study Time 110, Study Time in 5 Compulsory Bonus Form Yes None Written elaboration Written exam 90 minutes General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (English progr General Engineering Science (English progr General Engineering Science (English progr General Engineering Science (English progr General Engineering Science (English progr	Prof. Stefan Heinrich None Keine After taking part successfully, students have reached the followin After successful completion of the module students are able to name and explain processes and unit-operations of solids characterize particles, particle distributions and to discuss Students are able to choose and design apparatuses and processes for solids process document their work scientifically. The students are able to discuss scientific topics orally with ot technical-scientific issues in a group. Students are able to analyze and solve questions regarding solid p independent Study Time 110, Study Time in Lecture 70 So Mone Written elaboration sechs Berichte Written exam General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester): Spe General Engineering Science (English program, 7 semester): Spe General Engineering Science (English program, 7 semester): Spe General Engineering Science (English program, 7 semester): Spe Semeral Engineering Science (English program, 7 s	Recitation Section (small) Practical Course Prof. Stefan Heinrich None After taking part successfully, students have reached the following learning results After successful completion of the module students are able to • name and explain processes and unit-operations of solids process engineering, • characterize particles, particle distributions and to discuss their bulk properties Students are able to • choose and design apparatuses and processes for solids processing according to the de • asses solids with respect to their behavior in solids processing steps • document their work scientifically. The students are able to discuss scientific topics orally with other students or scientific preschnical-scientific issues in a group. Students are able to analyze and solve questions regarding solid particles independently. Independent Study Time 110, Study Time in Lecture 70 5 Compulsory Bonus Form Description Yets Yetten elaboration sechs Berichte (pro Versuch ein Bericht) à Written exam 20 minutes General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Science (English program, 7 semester): Specia	Recitation Section (small) 1 Prof. Stefan Heinrich 2 None

Course L0434: Particle Techr	nology I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 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 Tech	nology I
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0440: Particle Techr	nology I
Тур	Practical Course
Hrs/wk	2
CP	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 Environmental Assessment (L0860)		Typ Lecture	Hrs/wk 2	CP 2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements	None			
	Fundamentals of inorganic/organic chemistry and b	viology		
Knowledge	randamentals of morganic/organic enemistry and b	nology		
	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	Arter taking part successiony, students have reach	ca the following learning results		
-	With the completion of this module the student	ts acquire in-depth knowledge of import	ant cause-effect	chains of notent
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of environmental problems which might occur from production processes, projects or construction measures. They have k			
	about the methodological diversity and are competent			
	impacts. Besides the students are able to estimate	-		
	difficulties with their measurement.			
Skills	The students are able to select a suitable method	for the respective case from the variety o	f assessment me	ethods. Thereby th
	can develop suitable solutions for managing and m			
	out Life Cycle Impact Assessments independently	and can apply the software programs O	penLCA and the	database Ecolnve
	After finishing the course the students have th	e competence to critically judge resear	ch results or o	ther publications
	environmental impacts.			
Demonal Commetence				
Personal Competence	The students are able to discuss the various techni	cal and comptific tacks, both subject specif	ic and multidicci	nlinary Thoy are a
Social Competence	The students are able to discuss the various technic to develop jointly different solutions and to discu			
	to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lectur 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			
	social responsibilities in their role as engineers.			
Autonomv	The students learn to research, process and pres	sent a scientific topic independently. The	/ are able to ca	rry out independe
	scientific work. They can solve an environmental pr			
Workload in Hours	Independent Study Time 48, Study Time in Lecture	42		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	1 hour written exam			
scale				
Assignment for the	General Engineering Science (German program, 7 s	semester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German program, 7 s	semester): Specialisation Bioprocess Engine	eering: Elective (Compulsory
	General Engineering Science (German program, 7 s	semester): Specialisation Process Engineer	ing: Elective Con	npulsory
	Bioprocess Engineering: Core Qualification: Elective	e Compulsory		
	Energy and Environmental Engineering: Core Quality	fication: Compulsory		
	General Engineering Science (English program, 7 se	emester): Specialisation Bioprocess Engine	ering: Elective C	ompulsory
	General Engineering Science (English program, 7 se	emester): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 se	emester): Specialisation Process Engineeri	ng: Elective Com	pulsory
	Process Engineering: Core Qualification: Elective Co	ompulsory		

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

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

Specialization Electrical Engineering

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

Graduates will have

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

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

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

Module M0708: Electrical Engineering III: Circuit Theory and Transients

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Course 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, Dr. Fabian Lurz
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 Theory	/
Тур	Recitation Section (small)
Hrs/wk	2
CP	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
Literature	siehe korrespondierende Lehrveranstaltung
	see interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence Knowledge	This module deals with the foundations of the fun	ctionality of computing systems. It covor	s the lavers from	a the accomply lo
Knowledge	programming down to gates. The module includes t		s the layers non	in the assembly-les
	Introduction			
	Combinational logic: Gates, Boolean algebra,		ombinational net	works
	 Sequential logic: Flip-flops, automata, system Technological foundations 	hatic hardware design		
	Computer arithmetic: Integer addition, subtra	action multiplication and division		
	Basics of computer architecture: Programmir		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM			
	• Input/output: I/O from the perspective of the	CPU, principles of passing data, point-to-p	oint connections,	busses
Skills	The students perceive computer systems from the a	architect's perspective i.e. they identify t	he internal struct	ture and the physic
<i>o</i> , mo	composition of computer systems. The students car			
	collection of few and simple components. They are	e able to distinguish between and to expl	ain the different	abstraction layers
	today's computing systems - from gates and circuit	s up to complete processors.		
	After successful completion of the module, the stu	udents are able to judge the interdepend	lencies between	a physical compu
	system and the software executed on it. In particul			
	on the hardware-centric abstraction layers from the	e assembly language down to gates. This	way, they will be	enabled to evaluate
	the impact that these low abstraction levels have of	n an entire system's performance and to p	propose feasible o	options.
Personal Competence				
	Students are able to solve similar problems alone o	r in a group and to present the results acc	ordinaly.	
Autonomy	Students are able to acquire new knowledge from s	pecific literature and to associate this kno	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	e 56		
Credit points	6			
Course achievement		Description		
	Yes 10 % Excercises			
	Written exam 90 minutes, contents of course and labs			
scale	so minutes, contents of course and labs			
	General Engineering Science (German program, 7 s	emester): Specialisation Computer Science	e: Compulsory	
Following Curricula				ory
	General Engineering Science (German program, 7 s			
	General Engineering Science (German program, 7 s	emester): Specialisation Civil Engineering:	Compulsory	
	General Engineering Science (German program, 7 s	emester): Specialisation Electrical Enginee	ering: Compulsory	/
	General Engineering Science (German program, 7 s		5 1	2
	General Engineering Science (German program, 7 s		-	ring: Compulsory
	General Engineering Science (German program, 7 s General Engineering Science (German program,			Focus Mechatroni
		/ semester): specialisation Mechanica	5 - 5,	
	Compulsory General Engineering Science (German program,			
	Compulsory			
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical	l Engineering, F Engineering, Foc	ocus Biomechani us Aircraft System
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanic	I Engineering, F Engineering, Foc al Engineering,	ocus Biomechani us Aircraft System Focus Materials
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 s Engineering: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanica semester): Specialisation Mechanical Engir	I Engineering, F Engineering, Foc al Engineering, neering, Focus Th	ocus Biomechani us Aircraft System Focus Materials neoretical Mechani
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 s Engineering: Compulsory General Engineering Science (German program, 7	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanica semester): Specialisation Mechanical Engir	I Engineering, F Engineering, Foc al Engineering, neering, Focus Th	iocus Biomechani us Aircraft Syste Focus Materials teoretical Mechani
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	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 s Engineering: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical , 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine 7 semester): Specialisation Mechanical I Pry emester): Specialisation Computer Science emester): Specialisation Bioprocess Engine emester): Specialisation Naval Architecture emester): Specialisation Naval Architecture emester): Specialisation Civil Engineering:	I Engineering, F Engineering, Foc al Engineering, neering, Focus Th ineering, Focus F Engineering, Foc Engineering, Foc ering: Compulsory compulsory Compulsory	Focus Biomechani Lus Aircraft Syste Focus Materials Recoretical Mechani Product Developme us Energy Syster

	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
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
5	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
ā	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
	Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
r	Mechatronics: Core Qualification: Compulsory
۲ ا	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	Course L0321: Computer Engineering		
Тур	Lecture		
Hrs/wk	3		
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	 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 Eng	Course L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering I	: Time-Independent Fields (L0180)	Lecture	3	5
Theoretical Electrical Engineering I	: Time-Independent Fields (L0181)	Recitation Section (small)	2	1
Module Responsible	Prof. Christian Schuster			
Admission Requirements	None			
Recommended Previous	Basic principles of electrical engineering and ad	vanced mathematics		
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	Students can explain the fundamental formulas They can explicate the principal behavior of a sources. They can describe the properties of a fields. The students are aware of applications for these.	electrostatic, magnetostatic, and current de complex electromagnetic fields by means o	ensity fields with f superposition of	regard to respecti f solutions for simp
Skills	Students can apply Maxwell's Equations in electromagnetic field problems. Furthermore, 1 Equations for more general problems. The stude analyze these quantitatively. They can deduce electrical flow fields (capacitances, inductances	they are capable of applying a variety of ments can assess the principal effects of given meaningful quantities for the characterization	nethods that requ time-independent on of electrostatic	ire solving Maxwel t sources of fields a , magnetostatic, ar
Personal Competence Social Competence	Students are able to work together on subject r during exercise sessions).	elated tasks in small groups. They are able t	to present their re	esults effectively (e
Autonomy	Students are capable to gather necessary inform able to continually reflect their knowledge by m lectures and exercises that are related to the ex- learning process. They are able to draw conne- lectures (e.g. Electrical Engineering I, Linear Alg	eans of activities that accompany the lecture kam. Based on respective feedback, students actions between their knowledge obtained in	e, such as short of are expected to a	ral quizzes during t adjust their individu
Workload in Hours	Independent Study Time 110, Study Time in Lee	cture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Electrical Engine	eering: Compulsor	У
Following Curricula	Electrical Engineering: Core Qualification: Comp		•	
	Computational Science and Engineering: Specia	lisation II. Mathematics & Engineering Science	e: Elective Comp	ulsory
	Technomathematics: Specialisation III. Engineer	ring Science: Elective Compulsory		

	ectrical Engineering I: Time-Independent Fields Lecture
Hrs/wk	
CP	
	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster, Prof. Frank Gronwald
Language	DE
Cycle	SoSe
Content	- 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
	- 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 lectures in an interactive manner usin small MATLAB programs.
Literature	- 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)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Course L0181: Theoretical El	urse L0181: Theoretical Electrical Engineering I: Time-Independent Fields	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Christian Schuster	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Electrotechnical Experiments (L071		Lecture	1	1
Materials in Electrical Engineering (Lecture	2	3
Materials in Electrical Engineering (Recitation Section (small)	2	2
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous	Highschool level physics and mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students can explain the composition and the structural properties of materials used in electrical engineering. Students explicate the relevance of mechanical, electrical, thermal, dielectric, magnetic and chemical properties of materials in view of the applications in electrical engineering.			
Skills	Students can identify appropriate descriptive models and apply them mathematically. They can derive approximative solution and judge factors influential on the performance of materials in electrical engineering applications.			
Personal Competence Social Competence	Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of problem solving course.			
Autonomy	Students are capable to extract relevant information from the provided references and to relate this information to the content the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as ex- 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 L	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German progra	m. 7 semester); Specialisation Electrical Engi	neering: Compulsor	v
Following Curricula	Electrical Engineering: Core Qualification: Cor			,
	General Engineering Science (English program		eering: Compulsory	,
	Computational Science and Engineering: Spec			
	Orientierungsstudium: Core Qualification: Elec			

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

se L0685: Materials in E	ectrical Engineering
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	SoSe
Content	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator.
	Analysis of vibrations in a one-dimensional lattice.
	Phononic bandgap
	Introduction to quantum mechanics
	Wave function, Schrödinger's equation, observables and measurements.
	Quantum mechanical harmonic oscillator and spectral decomposition.
	Symmetries, conserved quantities, and the labeling of states. Angular momentum
	The hydrogen atom
	Waves in periodic potentials
	Reciprocal lattice and reciprocal lattice vectors
	Band gap
	Band diagrams
	The free electron gas and the density of states
	Fermi-Dirac distribution
	Density of charge carriers in semiconductors
	Conductivity in semiconductors. Engineering conductivity through doping.
	The P-N junction (diode)
	Light emitting diodes Electromagnetic waves interacting with materials
	Reflection and refraction
	Photonic band gaps
	Origins of magnetization
	Hysteresis in ferromagnetic materials
	Magnetic domains
Literature	1. Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials,
	Massachusetts Institute of Technology (MIT), 2013
	2.Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004
	3.Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994
	4.Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994
	5.Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979
	6.Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004
	7.Ashcroft, Mermin, Solid State Physics, Harcourt, 1976
	8.Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988
	9.Sze, Physics of Semiconductor Devices, Wiley, 1981
	10.Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007
	11.Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 2008
	12.Handley, Modern Magnetic Materials, Wiley, 2000
	13.Wikipedia, Wikimedia
	zo-micipedia, micinealia

Course L0687: Materials in E	ilectrical Engineering (Problem Solving Course)
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Manfred Eich
Language	DE
Cycle	SoSe
Content	 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				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0433)	- /	Recitation Section (small)	2	2
	Prof. Gerhard Bauch			
•	None Mathematica 1.2			
Recommended Previous Knowledge	Mathematics 1-3			
Kilowieuge	The modul is an introduction to the theory of signals and	systems. Good knowledge in maths	as covered by the	e moduls Mathema
	1-3 is expected. Further experience with spectral trans	ormations (Fourier series, Fourier tra	ansform, Laplace	transform) is usef
	but not required.			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
	The students are able to classify and describe signals a	nd linear time-invariant (LTI) systems	using methods of	of signal and syste
-	theory. They are able to apply the fundamental transfo			
	can describe and analyse deterministic signals and sys	tems mathematically in both time a	nd image domai	n. In particular, the
	understand the effects in time domain and image dom	ain which are caused by the transit	ion of a continu	ous-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determin			
	system theory. They can analyse and design basic s			
Borconal Compotonco	response, stability, linearity etc They can assess the im	pact of LTI systems on the signal pro	serties in time ar	id frequency doma
Personal Competence	The students can jointly solve specific problems.			
,	The students are able to acquire relevant informatic	n from appropriate literature source	es They can c	ontrol their level
Autonomy	knowledge during the lecture period by solving tutorial p			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ter): Specialisation Electrical Enginee	ering: Compulsor	y
-	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7 seme	ter): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7 seme	ter): Specialisation Bioprocess Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 seme	ter): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	Engineering, F	ocus Biomechanic
	Compulsory			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical I	Engineering, Foc	us Energy System
	Compulsory	mester). Cresislication Mechanical	Fraincaring For	we Aircraft Custon
	General Engineering Science (German program, 7 se Engineering: Compulsory	nester): specialisation Mechanical	ingineering, Foc	us Aircrait System
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering.	Focus Materials
	Engineering Sciences: Compulsory	·····	,	
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering, I	Focus Mechatronic
	Compulsory		-	
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engir	eering, Focus Th	neoretical Mechanic
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 semes General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 s			
	Compulsory	inester). Specialisation meenanical	Engineering, T	bioincentaine
	General Engineering Science (English program, 7 sei	nester): Specialisation Mechanical E	Engineering, Foc	us Energy System
	Compulsory			
	General Engineering Science (English program, 7 se	nester): Specialisation Mechanical I	Engineering, Foc	us Aircraft System
	Engineering: Compulsory			
	General Engineering Science (English program, 7 semes	er): Specialisation Mechanical Engine	ering, Focus Mat	terials in Engineerii
	Sciences: Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanica	l Engineering, l	Focus Mechatronic
	Compulsory			
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanic
	Engineering: Compulsory	on Compulsor		
	Computational Science and Engineering: Core Qualificat Mechatronics: Core Qualification: Compulsory	on compusory		

Course L0432: Signals and S	vstems
Тур	
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	
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.
4	<u> </u>

Course 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

Module M0854: Mathe	ematics IV			
Courses		_		
Title Differential Equations 2 (Partial Diff	ferential Equations) (L1043)	Typ Lecture	Hrs/wk 2	СР 1
Differential Equations 2 (Partial Diff		Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff		Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous	Mathematics 1 - III			
Knowledge				
	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	 Students can name the basic concepts in Mathematics IV 	. They are able to explain ther	n using appropri	ate examples.
	Students can discuss logical connections between these	concepts. They are capable	of illustrating th	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce them. 			
Skills				
	Students can model problems in Mathematics IV with th		ed in this course	. Moreover, they are
	capable of solving them by applying established methods		and a start of the state of	
	Students are able to discover and verify further logical co			
	 For a given problem, the students can develop and ex results. 	ecute a suitable approach, a	nu are able to c	nucally evaluate the
	results.			
Demonstration of the second se				
Personal Competence				
Social Competence	 Students are able to work together in teams. They are ca 	pable to use mathematics as	a common langu	age.
	In doing so, they can communicate new concepts accord	ling to the needs of their coop	erating partners	. Moreover, they can
	design examples to check and deepen the understanding	g of their peers.		
Autonomy				
	 Students are capable of checking their understanding of any single and language to get balls in a chains them. 	f complex concepts on their o	wn. They can sp	ecity open questions
	precisely and know where to get help in solving them.	his to work for longer period	a in a goal arian	ted meaning on boud
	 Students have developed sufficient persistence to be a problems. 	ible to work for longer period	s in a goal-orien	ted manner on nard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points				
Course achievement				
Examination				
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equations 2)			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Sp	-		
Following Curricula	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanica	i Engineering,	Focus Mechatronics:
	Compulsory General Engineering Science (German program, 7 semester): S	nocialization Mochanical Engir	pooring Focus Th	operatical Machanical
	Engineering: Compulsory	pecialisation mechanical Engli	leering, Focus II	
	General Engineering Science (German program, 7 semester): Sp	necialisation Naval Architectur	e: Compulson	
	Computer Science: Specialisation Computational Mathematics:		e. compulsory	
	Electrical Engineering: Core Qualification: Compulsory	Elective compaisory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Electrical Engineer	rina: Compulsorv	
	General Engineering Science (English program, 7 semeste			
	Compulsory		5 5	
	General Engineering Science (English program, 7 semester): S	pecialisation Mechanical Engin	eering, Focus Th	neoretical Mechanical
	Engineering: Compulsory	5		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture	: Compulsory	
	Computational Science and Engineering: Specialisation II. Mathe			llsory
	Computational Science and Engineering: Specialisation Comput	er Science: Elective Compulso	ry	
	Computational Science and Engineering: Specialisation Enginee	ring Sciences: Elective Compu	lsory	
	Mechanical Engineering: Specialisation Theoretical Mechanical R	Engineering: Compulsory		
	Mechanical Engineering: Specialisation Mechatronics: Compulse	ory		
	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
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
Literature	 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 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

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

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

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

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

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

Courses					
Courses					
Fitle	nac and Electromagnetic Compatibility (11660)	Typ Lecture	Hrs/wk 3	CP 4	
	nas, and Electromagnetic Compatibility (L1669) nas, and Electromagnetic Compatibility (L1877)	Recitation Section (small)	2	2	
	Prof. Christian Schuster				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have reached t	ne following learning results			
Professional Competence					
Knowledge	Students can explain the basic principles, relationship	s, and methods for the design of wa	veguides and an	tennas as well a	
	Electromagnetic Compatibility. Specific topics are:				
	- Fundamental properties and phenomena of electrical	circuits			
	 Steady-state sinusoidal analysis of electrical circuits 				
	 Fundamental properties and phenomena of electroma 	gnetic fields and waves			
	- Steady-state sinusoidal description of electromagnetic				
	- Useful microwave network parameters				
	- Transmission lines and basic results from transmission	n 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				
Skille	Students know how to apply various methods and mo	dels for characterization and choice of	f waveguides and	antennas They	
JKIIIS	Students know how to apply various methods and models for characterization and choice of waveguides and antennas. They a able to assess and qualify their basic electromagnetic properties. They can apply results and strategies from the field				
	Electromagnetic Compatibility to the development of electrical components and systems.				
Personal Competence					
Social Competence	Students are able to work together on subject related	tasks in small groups. They are able	to present their	results effective	
	English (e.g. during small group exercises).				
Autonomy	Students are capable to gather information from sul	ject related, professional publication	s and relate tha	t information to	
	context of the lecture. They are able to make a conne	ction between their knowledge obtair	ed in this lecture	e with the conter	
	other lectures (e.g. theory of electromagnetic fields, fundamentals of electrical engineering / physics). They can discuss technic				
	problems and physical effects in English.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	45 min				
scale					
÷	General Engineering Science (German program, 7 sem				
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory				
	Electrical Engineering: Core Qualification: Elective Com Electrical Engineering: Core Qualification: Compulsory	pulsory			
	Aircraft Systems Engineering: Specialisation Air Transp	ortation Systems: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Air Transp				
	Aircraft Systems Engineering: Specialisation Air Transp				
	Aircraft Systems Engineering: Specialisation Cabin Syst				
	General Engineering Science (English program, 7 seme		ring: Compulsory		
	General Engineering Science (English program, 7 seme	ster): Specialisation Electrical Enginee	ring: Elective Cor	npulsory	
	Mechatronics: Specialisation System Design: Elective C	ompulsory			
	Mechatronics: Specialisation System Design: Elective C	ompulsory			

Тур	Lecture		
Hrs/wk	3		
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Christian Schuster		
Language	DE/EN		
Cycle	SoSe		
-	 This course is intended as an introduction to the topics of wave propagation, guiding, sending, and receiving as well Electromagnetic Compatibility (EMC). It will be useful for engineers that face the technical challenge of transmitting high frequen / high bandwidth data in e.g. medical, automotive, or avionic applications. Both circuit and field concepts of wave propagation and Electromagnetic Compatibility will be introduced and discussed. Topics: 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 Stundental 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 		
Literature	- Zinke, Brunswig, "Hochfrequenztechnik 1", Springer (1999)		
	- J. Detlefsen, U. Siart, "Grundlagen der Hochfrequenztechnik", Oldenbourg (2012)		
	- 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: Introduction t	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		

Courses					
Title		Тур	Hrs/wk	СР	
ntroduction to Communications ar	d Random Processes (L0442)	Lecture	3	4	
ntroduction to Communications an		Recitation Section (large)	1	1	
Introduction to Communications an	d Random Processes (L2354)	Recitation Section (small)	1	1	
Module Responsible	Prof. Gerhard Bauch				
Admission Requirements	None				
Recommended Previous	Mathematica 1 2				
Knowledge	Mathematics 1-3				
	 Signals and Systems 				
Educational Objectives	After taking part successfully, students have	e reached the following learning results			
Professional Competence					
Knowledge	The students know and understand the fun	damental building blocks of a communications	system. They can o	describe and analy	
	the individual building blocks using knowled	dge of signal and system theory as well as the	theory of stochasti	ic processes. The a	
	aware of the essential resources and evaluation criteria of information transmission and are able to design and evaluate a basic				
	communications system.				
Skills	Skills The students are able to design and evaluate a basic communications system. In particular, they can est			stimate the requi	
resources in terms of bandwidth and power. They are able to assess essential evaluation parameters o			-		
	system such as bandwidth efficiency or bit e	error rate and to decide for a suitable transmissi	on 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 solv	ing tutorial problems, software tools, clicker sys	tem.		
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German progr	ram, 7 semester): Specialisation Electrical Engin	eering: Compulsor	У	
Following Curricula	Computer Science: Specialisation Computer	and Software Engineering: Elective Compulsory	,		
	Computer Science: Specialisation Computat	ional Mathematics: Elective Compulsory			
	Data Science: Core Qualification: Elective Co				
	Electrical Engineering: Core Qualification: C	ompulsory			
		am, 7 semester): Specialisation Electrical Engine	ering: Compulsory	,	
	Computational Science and Engineering: Co		5 5		
	Computational Science and Engineering: Sp	ecialisation Engineering Sciences: Elective Com	pulsory		

Course L0442: Introduction t	o Communications and Random Processes
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	WiSe
Content	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)
	• Analog uigital conversion. Sampling, quantization, puisecode modulation (PCM)
	Fundamentals of information theory, source coding, channel coding
	 Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability
	Fundamentals of digital modulation
Literature	K. Kammeyer: Nachrichtenübertragung, Teubner
	P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner.
	M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg.
	J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium.
	J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill.
	S. Haykin: Communication Systems. Wiley
	J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall.
	J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning.

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

Course L2354: Introduction t	ourse L2354: Introduction to Communications and Random Processes		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	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				
Title		Тур	Hrs/wk	СР
-	tion to Electrical Power Systems (L1670)	Lecture	3	4
	tion to Electrical Power Systems (L1671)	Recitation Section (large)	Z	Z
Module Responsible				
Admission Requirements				
	Fundamentals of Electrical Engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students are able to give an overview of convention			
	evaluate technologies of electric power generation	, transmission, storage, and distribution as	well as integrati	on of equipment ir
	electric power systems.			
Skills	//s With completion of this module the students are able to apply the acquired skills in applications of the design, integra			design, integratio
<i>Brins</i>	development of electric power systems and to ass			design, meegradie
Personal Competence				
Social Competence	e The students can participate in specialized and interdisciplinary discussions, advance ideas and represent their own work results			
	front of others.			
Διιτοροφγ	Students can independently tap knowledge of the	emphasis of the lectures		
Autonomy	Students can independently tap knowledge of the	emphasis of the lectures.		
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Electrical Engine	ering: Elective Co	mpulsory
Following Curricula	Data Science: Core Qualification: Elective Compuls	ory		
	Electrical Engineering: Core Qualification: Elective	Compulsory		
	Energy and Environmental Engineering: Specialisa	ion Energy Engineering: Elective Compulse	ory	
	Energy Systems: Specialisation Energy Systems: E	ective Compulsory		
	General Engineering Science (English program, 7 s		-	
	Computational Science and Engineering: Specialisa			ilsory
	Computational Science and Engineering: Specialisa		llsory	
	Renewable Energies: Core Qualification: Compulso	•		
	Theoretical Mechanical Engineering: Technical Con			
	Theoretical Mechanical Engineering: Specialisation	Energy Systems: Elective Compulsory		

Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Christian Becker
Language	DE
Cycle	WiSe
Content	
	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
	 induction 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
	 network modelling
	 load flow calculation
	 (n-1)-criterion
	symmetric failure calculations, short-circuit power
	control in networks and power stations
	grid protection
	grid planning
	power economy fundamentals
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013
	A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Becker
Language	DE
Cycle	WiSe
Content	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
	 induction 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
	network modelling
	 load flow calculation
	 (n-1)-criterion
	 symmetric failure calculations, short-circuit power
	control in networks and power stations
	grid protection
	grid planning
	power economy fundamentals
Literature	K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013
	A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017
	R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008

Courses					
Title			Тур	Hrs/wk	СР
EE Experimental Lab (L0781)			Practical Course	2	2
Measurements: Methods and Data	-		Lecture	2	3
Measurements: Methods and Data	Processing (L0780)		Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schlaefer				
Admission Requirements	None				
Recommended Previous	principles of mathematics				
Knowledge	principles of electrical engin	eering			
-	After taking part successfull	y, students have reached	the following learning results		
Professional Competence					
Knowledge	The students are able to ex	plain the purpose of met	rology and the acquisition and process	sing of measurem	ents. They can deta
	aspects of probability theory	and errors, and explain	the processing of stochastic signals. St	udents know met	nods to digitalize a
	describe measured signals.				
Skills	The students are able to eva	luate problems of metrol	ogy and to apply methods for describir	ig and processing	of measurements.
Personal Competence					
•	? The students solve problems in small groups.				
Social competence		in shan groupsi			
Autonomy	The students can reflect the	ir knowledge and discuss	and evaluate their results.		
Workload in Hours	Independent Study Time 11), Study Time in Lecture 7	0		
Credit points	6				
Course achievement	Compulsory Bonus Form	De	scription		
	Yes 10 % Exce	rcises			
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science	e (German program, 7 ser	nester): Specialisation Electrical Engine	eering: Elective Co	mpulsorv
	Electrical Engineering: Core				· /
i onowing curricula			ester): Specialisation Electrical Engine	ering: Elective Cor	mulsory
				-	iipuisoi y
			n Computer Science: Elective Compuls		
			n Engineering Sciences: Elective Comp	ouisory	
	Technomathematics: Specia	lisation III. Engineering Sc	ience: Elective Compulsory		

Course L0781: EE Experimen	tal Lab	
Тур	Practical Course	
Hrs/wk	2	
CP	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. Herber	
	Werner, Dozenten des SD E, Prof. Heiko Falk, Prof. Thorsten Kern	
Language	DE	
Cycle	WiSe	
Content	lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines	
Literature	Wird in der Lehrveranstaltung festgelegt	

Course L0779: Measurements: Methods and Data Processing		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	WiSe	
Content	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: Measurement	Course L0780: Measurements: Methods and Data Processing		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Alexander Schlaefer		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses					
Title		Тур	Hrs/wk	СР	
Theoretical Electrical Engineering I		Lecture	3	5	
Theoretical Electrical Engineering		Recitation Section (small)	2	1	
	Prof. Christian Schuster				
Admission Requirements	None				
Recommended Previous Knowledge	Electrical Engineering I, Electrical Engineering II,	Theoretical Electrical Engineering I			
Kilowieuge	Mathematics I, Mathematics II, Mathematics III, M	1athematics IV			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence					
Knowledge			-		
	electromagnetic fields. They can assess the prir regard to respective sources. They can describ		-		
	solutions for simple fields. The students are awa				
	able to explicate these.			- 5	
Skills	Students are able to apply a variety of procedure	es in order to solve the diffusion and the wa	ve equation for ge	ve equation for general time-dependen	
	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		-	skin depth, Poyntin	
	vector, radiation resistance, etc.) from given field	as and interpret them with regard to practi-	ai applications.		
Personal Competence					
Social Competence	Students are able to work together on subject re	lated tasks in small groups. They are able	to present their re	sults effectively (e.	
	during exercise sessions).				
Autonomy	Students are capable to gather necessary inform	ation from provided references and relate	his information to	the lecture. They a	
Autonomy	able to continually reflect their knowledge by me			-	
	lectures and exercises that are related to the ex-				
	learning process. They are able to draw con				
	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 Lect	cure 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90-150 minutes				
scale		7 compositor). Cresialization Electrical English	eering. Commuter		
Assignment for the Following Curricula	General Engineering Science (German program, Electrical Engineering: Core Qualification: Comp		eering: compulsor	У	
i showing curricula	Technomathematics: Specialisation III. Engineeri				

Course L0182: Theoretical El	ectrical Engineering II: Time-Dependent Fields
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	
Cycle	
Content	- 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
	- Polarization and superposition of planar waves
	- Reflection and refraction of planar waves at boundary surfaces
	- Waveguide theory
	- Rectangular waveguide, planar optical waveguide
	- Elektrical and magnetical dipol radiation
	- Simple arrays of antennas
	The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner using small MATLAB programs.
Literature	- 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)
	- D. Griffiths, "Introduction to Electrodynamics", Pearson (2012)
	- J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013)
	- Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011)

Course L0183: Theoretical Electrical Engineering II: Time-Dependent Fields		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Christian Schuster	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses						
Title			Тур		Hrs/wk	СР
Electronic Devices (L0720) Electronic Devices (L0721)			Lecture Project /	arablem based Learning	3 2	4 2
	Prof. Hoc Khiem Trieu		Project-/	problem-based Learning	Z	Z
Module Responsible Admission Requirements	None					
Recommended Previous		theory, electrical	currents in solid state mate	rials, basics in solid-stat	e physics	
Knowledge						
	Successful participation of F	Physics for Enginee	rs and Materials in Electrica	al Engineering or course	s with equiva	lent contents
Educational Objectives	After taking part successful	y, students have r	eached the following learning	ng results		
Professional Competence						
Knowledge						
	Students are able					
	 to represent the basis 	cs of semiconducto	or physics,			
	 to explain the operat 	ing principle of imp	ortant semiconductor devi	ces,		
	 to outline device characteristic 	racteristics and eq	uivalent circuits as well as t	o explain their derivatio	on and	
	 to discuss the limitation 	ion of device mode	IS.			
Skills						
	Students are capable					
	 to apply devices in back 	asic circuits,				
	 to realize the physica 	I context and to so	lve complex problems by o	neself		
Personal Competence						
Social Competence	Students are able to prepare and perform their lab experiments in team work as well as to present and discuss the results in fro					
	of audience.					
Autonomy	Students are capable to acc	juire knowledge ba	sed on literature in order to	prepare their experime	ents.	
Workload in Hours	Independent Study Time 11	0, Study Time in L	ecture 70			
Credit points						
Course achievement	Compulsory Bonus Form Yes 10 % Subj	ect theoretical	Description andStudierenden erarbeit	en in Kleingruppen Wis	con zu oinom	hestimmten Them
	,	tical work		s in Form eines Ve		
				hinaus betreut jede G		
			inhaltlich zu dem jewe	iligen Versuch gehört.		
Examination	Written exam					
Examination duration and	120 min					
scale	0 15 1 1 5 1	(2)				
	General Engineering Science Electrical Engineering: Core			on Electrical Engineering	g: Compulsor	/
Following Curricula	Engineering Science: Specia					
	General Engineering Science			n Electrical Engineering	: Compulsory	
	Computational Science and					

Course L0720: Electronic Dev	vices
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Hoc Khiem Trieu
Language	DE
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 of 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, ohmic contact; junction field effect transistor: operating principle, current-voltage characteristics, small-signal model, breakdown characteristics; MOSFET: operating principle, depletion mode and 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: Physik der Halbleiterbauelemente, Springer (2011) T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004) B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005) D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011) M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996) S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007) H. Schaumburg: Halbleiter, B.G. Teubner (1991) A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992) HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985)

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

urses				
le		Тур	Hrs/wk	СР
niconductor Circuit Design (L07	63)	Lecture	3	4
niconductor Circuit Design (L08	64)	Recitation Section (small)	1	2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	None			
Recommended Previous	Fundamentals of electrical engineering			
Knowledge	Basics of physics, especially semiconductor p	hysics		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence Knowledge	 Students are able to explain the function Students are able to explain how analor Students are able to explain the function Students know the fundamental digital 	onality of different MOS devices in electronion og circuits functions and where they are app onality of fundamental operational amplifier logic circuits and can discuss their advanta ory circuits and can explain their functionalit or the use of bipolar transistors.	lied. s and their specificatio ges and disadvantage	
Skills	 Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits. Students are able to develop different logic circuits and can design different types of logic circuits. Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications. 			ctronic circuits.
Personal Competence Social Competence	Students are able work efficiently in he	eterogeneous teams. Sups can solve problems and answer profess	ional questions.	
Autonomy	Students are able to assess their level	of knowledge.		
Workload in Hours	Independent Study Time 124, Study Time in I	ecture 56		
Credit points				
Course achievement				
	Written exam			
Examination duration and				
scale				
Assignment for the		m. 7 semester): Specialisation Electrical End	ineering: Compulsory	/
-	General Engineering Science (German pro			
	Compulsory			
	Data Science: Core Qualification: Elective Cor	npulsory		
	Electrical Engineering: Core Qualification: Cor	npulsory		
	Engineering Science: Specialisation Electrical	Engineering: Compulsory		
	Engineering Science: Specialisation Mechatro	nics: Compulsory		
	General Engineering Science (English program	n, 7 semester): Specialisation Electrical Eng	neering: Compulsory	
	General Engineering Science (English pro-	gram, 7 semester): Specialisation Mecha	nical Engineering, F	ocus Mechatron
	Compulsory			
	General Engineering Science (English program		1	
	Computational Science and Engineering: Spec		ence: Elective Compu	lsory
	Mechanical Engineering: Specialisation Mecha			
	Mechanical Engineering: Specialisation Mecha Mechatronics: Core Qualification: Compulsory Technomathematics: Specialisation III. Engine	1		

rse L0763: Semiconducto	
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 78, Study Time in Lecture 42
	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

Course L0864: Semiconducto	or Circuit Design
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl, 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 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Module M0734: Electr	rical Engineering Project Laboratory
Courses	
Title	Typ Hrs/wk CP
Electrical Engineering Project Labor	ratory (L0640) Project-/problem-based Learning 8 6
Module Responsible	Prof. Christian Becker
Admission Requirements	None
	Electrical Engineering I, Electrical Engineering II
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	After taking part successfully, stadents have reached the following learning results
-	Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate
	respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate
	technical language. They can explain the typical process of solving practical problems and present related results.
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems.
	They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students are
	able to develop, compare, and choose conceptual solutions for non-standardized problems.
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the
	context of electrical engineering. They are able to effectively present and explain their results alone or in groups in front of a
	qualified audience. Students have the ability to develop alternative approaches to an electrical engineering problem independently or in groups and discuss advantages as well as drawbacks.
	independentity of in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps
,	in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can
	meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112
Credit points	6
	Subject theoretical and practical work
	based on task + presentation
scale	Constal Engineering Science (Corman program, 7 constar), Specialisation Electrical Engineering, Compulson,
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core Qualification: Compulsory
ronowing curricula	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Course L0640: Electrical Eng	ineering Project Laboratory
Тур	Project-/problem-based Learning
Hrs/wk	8
CP	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	
	units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, power electronics based
	inverters, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.
Literature	Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources
	that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).

Specialization Energy and Enviromental Engineering

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

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

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science responds to two developments: on the one hand the increasing significance of environmental protection through CO_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						
ïtle			Тур	Hrs/wk	СР	
omputer Engineering (L0321)			Lecture	3	4	
omputer Engineering (L0324)			Recitation Section (small)	1	2	
Module Responsible	Prof. Heiko Falk					
Admission Requirements	None					
Recommended Previous	Basic knowledge in elect	rical engineering				
Knowledge						
Educational Objectives	After taking part success	fully, students have reached th	e following learning results			
Professional Competence						
Knowledge	This module deals with	the foundations of the functio	nality of computing systems. It cove	ers the layers from	n the assembly-le	
	programming down to g	ates. The module includes the f	ollowing topics:			
	 Introduction 					
		ic: Gates, Boolean algebra, Boo	lean functions, hardware synthesis,	combinational net	works	
	-	lip-flops, automata, systematic				
	Technological foundations					
	Computer arithmetic: Integer addition, subtraction, multiplication and division					
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining					
	Memories: Memory hierarchies, SRAM, DRAM, caches					
	 Input/output: I/O f 	rom the perspective of the CPL	, principles of passing data, point-to-	point connections	, busses	
Skills The students perceive computer systems from the architect's perspective, i.e., they identify the internal structu						
	composition of computer systems. The students can analyze, how highly specific and individual computers can be built collection of few and simple components. They are able to distinguish between and to explain the different abstracti today's computing systems - from gates and circuits up to complete processors.					
					abstraction layers	
	today's computing syste	ms - from gates and circuits up	to complete processors.			
	After successful completion of the module, the students are able to judge the interdependencies between a physica				a physical compu	
	system and the software	e executed on it. In particular,	hey shall understand the consequer	ces that the exec	ution of software	
	on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enab				e enabled to evalu	
	the impact that these lo	v abstraction levels have on an	entire system's performance and to	propose feasible of	options.	
Personal Competence						
Social Competence	Students are able to solv	e similar problems alone or in	a group and to present the results ac	cordingly.		
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.					
Workload in Hours	Independent Study Time	124, Study Time in Lecture 56				
Credit points	6					
Course achievement			ription			
		xcercises				
	Written exam					
Examination duration and	90 minutes, contents of	course and labs				
scale	0 15 1 5 5			<u> </u>		
-			ster): Specialisation Computer Scien			
Following Curricula			ster): Specialisation Bioprocess Engi	÷ .	ргу	
	5 5		ster): Specialisation Naval Architectu ster): Specialisation Civil Engineering	1		
		ence (German program, 7 seme ence (German program, 7 seme				

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

Course L0321: Computer Eng	jineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 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.

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

	amentals of Materials Science				
Courses					
Title		Тур	Hrs/wk	СР	
Fundamentals of Materials Science	I (L1085)	Lecture	2	2	
Fundamentals of Materials Science	Lecture	2	2		
Physical and Chemical Basics of Ma	terials Science (L1095)	Lecture	2	2	
Module Responsible	Prof. Jörg Weißmüller				
Admission Requirements	None				
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results			
Professional Competence					
Knowledge	The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. The for materials and can identify relevant approaches for char phenomena back to the underlying physical and chemical laws	cally the issues of ato he students know abo aracterizing specific	omic structure, microstructu out the key aspects of char	ure, phase diagra acterization met	
Skills	The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Mater phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corros resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relat between processing conditions and the materials microstructure, and they can account for the impact of microstructure on material's behavior.				
Personal Competence					
Social Competence	-				
Autonomy	-				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and	180 min				
scale					
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Mechan	nical Engineering: Compulso	ory	
Following Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Biomed	lical Engineering: Compulso	ory	
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory				
	Energy and Environmental Engineering: Core Qualification: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Sp				
	General Engineering Science (English program, 7 semester): Sp		and Enviromental Engineeri	ng: Compulsory	
	Logistics and Mobility: Specialisation Engineering Science: Elect	tive Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory				
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Ele	activo Computant			

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

Course L1095: Physical and C	Chemical Basics of Materials Science			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Stefan Fritz 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", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer 			

Courses						
			True		Line (usis	CD.
Title Embodiment Design and 3D-CAD (I	0269)		Typ Lecture		Hrs/wk 2	CP 1
Mechanical Design Project I (L0695			Project-/problem-base	ad Learning	2	2
			Project-/problem-base		3	2
Mechanical Design Project II (L0592) Team Project Design Methodology (L0267)			Project-/problem-basi		2	1
Module Responsible				cu zeurring	-	-
Admission Requirements						
Recommended Previous	-					
	 Fundamentals 	s of Mechanical Engineerin	g Design			
Knowledge	 Mechanics 					
	 Fundamentals 	s of Materials Science				
	 Production En 	gineering				
Educational Objectives	After taking part suc	cessfully, students have re	eached the following learning results			
Professional Competence						
Knowledge	After passing the mo	odule, students are able to				
	 explain design 	n quidelines for machinery	parts e.g. considering load situation, r	materials an	d manufactur	ina requirement
	describe basic		parts eigi considering load situation, i			ing requirements
		s methods of engineering o	lesianina			
		includes of engineering e				
Skills	After passing the mo	odule, students are able to	:			
	independently create sketches, technical drawings and documentations e.g. using 3D CAD					
	 independently create sketches, technical drawings and documentations e.g. using 3D CAD, design generate based on design guidelings autonomously. 					
	design components based on design guidelines autonomously,					
		Iculate) used components				
			ering design tasks systamtically and s	olution-orie	ntea,	
	 apply creativity 	ty 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, 					
		use of scientific methods,				
			ical drawings within groups,			
	 reflect the ow 	n results in the work group	os of the course.			
Διιτοροφγ	Students are able					
Autonomy	Students are able					
	 to estimate t 	heir level of knowledge usi	ng activating methods within the lect	ures (e.g. w	ith clickers),	
	To solve engineering design tasks systematically.					
Werklood in Hours	Indonondont Chudu 7	Finan 40. Chudu Tinan in Los	ture 140			
Credit points		Fime 40, Study Time in Lec				
•		Form	Description			
Course achievement	Yes None	Written elaboration	Teamprojekt Konstruktionsmetho	dik		
	Yes None	Written elaboration	Konstruktionsprojekt 1			
	Yes None	Written elaboration	Konstruktionsprojekt 2			
	Yes None	Written elaboration	3D-CAD-Praktikum			
Examination						
Examination duration and						
scale						
	General Engineering	Science (German program	n, 7 semester): Specialisation Mechani	cal Enginee	ring: Compuls	ory
Following Curricula			•	-	÷ .	-
. ee.thig current	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory					
	Energy and Environmental Engineering: Core Qualification: Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory					
				-	• ·	-
			, 7 semester): Specialisation Energy ar	nd Envirome	ental Engineer	ing: Compulsory
		ring: Core Qualification: Co	mpulsory			
	Mechatronics: Core Qualification: Compulsory					
	Naval Architocturo: (Core Qualification: Compul				

Course L0268: Embodiment I	Design and 3D-CAD
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	 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. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., 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: Mechanical D	esign Project I			
Тур	Project-/problem-based Learning			
Hrs/wk				
СР				
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42			
Lecturer	Prof. Thorsten Schüppstuhl			
Language	DE			
Cycle	WiSe			
Content	 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: Mechanical D	esign 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.

ourse L0267: Team Project	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. Sowie weitere Bücher zu speziellen Themen

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Fluid Mechanics (I	0091)	Lecture	2	4
Fluid Mechanics for Process Engine		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I+II+III			
Kilowieuge	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances Cimplification and solving of partial different	tiel equations		
	Simplification and solving of partial differentIntegration			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students are able to:			
	explain the difference between different typ	oc of flow		
	 give an overview for different applications o 		ss engineering	
	explain simplifications of the Continuity- and			ions
Skills	The students are able to			
	 describe and model incompressible flows many reduce the governing equations of fluid mediations 		ative solutions e	a by integration
	 notice the dependency between theory and 		ative solutions e	.g. by integration
	 use the learned basics for fluid dynamical a 			
Demonstration of the second				
Personal Competence Social Competence	The students			
Social competence				
	are capable to gather information from sub	ject related, professional publications and	relate that inforr	nation to the conte
	of the lecture and • able to work together on subject related ta	sks in small groups. They are able to pres	ont their results	effectively in Engl
	(e.g. during small group exercises)	sks in small groups. They are able to pres	ent then results	enectively in Lingi
	are able to work out solutions for exercises	by themselves, to discuss the solutions ora	lly and to presen	t the results.
Autonomy	The students are able to			
	 search further literature for each topic and t 	to expand their knowledge with this literatu	ıre,	
	 work on their exercises by their own and to 			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points				
Course achievement		Description		
	Yes 5 % Midterm			
Examination				
Examination duration and	3 hours			
scale		comestar), Chesieliestian Provide T	ing. Concertes	
-	General Engineering Science (German program, 7 General Engineering Science (German program, 7			orv
i cheving current	General Engineering Science (German program, 7 General Engineering Science (German program, 7			-
	Bioprocess Engineering: Core Qualification: Compu		5.00	5 1
	Energy and Environmental Engineering: Core Qual	ification: Compulsory		
	General Engineering Science (English program, 7 s	emester): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 s			-
	General Engineering Science (English program, 7 s		omental Engineer	ing: Compulsory
	Technomathematics: Specialisation III. Engineering	J SCIENCE: Elective Compulsory		

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
CP	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: Eine Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 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

Course L0092: Fluid Mechani	ics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 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

Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines and Actuators	L0293)	Lecture	3	4
Electrical Machines and Actuators	L0294)	Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular complexe numb	ers, integrals, differentials		
Knowledge	Basics of electrical engineering and mechanical engi	neering		
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic principle	es of electric and magnetic fields.		
	They can describe the function of the standard	turnes of electric machines and proce	at the component	ding aquations of
	They can describe the function of the standard types of electric machines and present the corresponding equation characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole s from the power grid to the driven engine.			
Skills	Students arw able to calculate two-dimensional ele this they apply the usual methods of the design auf		rromagnetic circ	uits with air gap. F
	They can calulate the operational performance of e and characteristic curves. They apply the usual equi		cteristic data an	d selected quantiti
Personal Competence Social Competence Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	120 Minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se	emester): Specialisation Electrical Enginee	ering: Elective Co	mpulsory
	Electrical Engineering: Core Qualification: Elective Co	ompulsory		
	Energy and Environmental Engineering: Core Qualified	cation: Compulsory		
	General Engineering Science (English program, 7 se	mester): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical Engine	eering: Elective C	ompulsory
	General Engineering Science (English program, 7 se	mester): Specialisation Electrical Engineer	ring: Elective Cor	mpulsory
	Computational Science and Engineering: Specialisati	on Engineering Sciences: Elective Compu	lsory	
	Logistics and Mobility: Specialisation Engineering Sci	ience: Elective Compulsory		
	Mechanical Engineering: Core Qualification: Elective	Compulsory		
	Mechatronics: Core Qualification: Compulsory			

Course L0293: Electrical Mac	hines 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
Content	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
	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
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313
	Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122
	"Grundlagen der Elektrotechnik" - anderer Autoren
	Fachbücher "Elektrische Maschinen"

Course L0294: Electrical Mac	Course 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	

Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Indust	ry (L0315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
	With completion of this module, the students c	an provide an overview of characteristics o	f enerav systems	and their econo
	efficiency. They can explain the issues occurring			
	distribution and power trading wih regard to			
	applicable to many energy systems in general,		id critical discuss	s them. Furthermo
	the students can explain the environmental bene	ents from the use of such systems.		
Skills	Students are able to apply methodologies for de			
	energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design the			
	under certain given conditions. Therefore, th	ney can choose the necessary subject-spe	ecific calculation	rules, also for
	standardized solutions of a problem.			
	The students are able to explain questions and	nossible approaches to its processing from	the field of renew	vable energies or
	and to put them them into the right context.	possible approaches to its processing nom	the field of fellev	vable ellergies of
	and to put them them into the right context.			
Personal Competence				
Social Competence	The students are able to analyze suitable tech	nnical alternatives and to assess them with	technical, econo	mical and ecolog
	criteria under sustainability aspects. This allows			
Autonomy	Students can independently exploit sources , a	acquire the particular knowledge about the	subject area and	transform it to i
	questions.			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	10.94		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German program)		-	
i onowing curriculd	Elective Compulsory	n, / semestery, specialisation mechalilitat	Lingineering, POC	as Energy Syste
		7 competer), Englishing Presses Frank	ing Elective Com	nulcon
	General Engineering Science (German program,		ing: Elective Com	ipulsory
	Energy and Environmental Engineering: Core Qu			
	General Engineering Science (English program, 7		-	
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syste
	Elective Compulsory			
	General Engineering Science (English program, 7	7 semester): Specialisation Process Engineeri	ng: Elective Com	pulsory

Course L0316: Power Industr	y
Тур	Lecture
Hrs/wk	1
CP	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	Cost and efficiency calculation Folien der Vorlesung

Course L0315: Energy System	ns and Energy Industry
Тур	Lecture
Hrs/wk	2
CP	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: Renewable Er	lergy
Тур	Lecture
Hrs/wk	2
CP	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

ourse L1434: Renewable Energy		
	Recitation Section (small)	
Hrs/wk		
CP		
	Independent Study Time 16, Study Time in Lecture 14	
	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
Practical Exercise Environmental Te	echnology (L1387)			Practical Course	1	1
Environmental Technologie (L0326)			Lecture	2	2
Module Responsible	Prof. Martin Kaltschm	nitt				
Admission Requirements	None					
Recommended Previous	Fundamentals of inor	rganic/organic chemis	try and biology			
Knowledge						
Educational Objectives	After taking part succ	cessfully, students ha	ve reached the follow	ing learning results		
Professional Competence						
Knowledge	With the completion	of this modul the stud	lents obtain profound	knowledge of environme	ental technology. They	are able to descri
	the behaviour of che	emicals in the environ	ment. Students can g	jive an overview of scier	tific disciplines involve	ed. They can expla
	terms and allocate th	hem to related metho	ds.			
Skille	Students are able to	o proposo appropriate	management and n	nitigation measures for e	anvironmontal problem	as Thoy are able
SKIIIS			-	-		
	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 presen					
		inons in front of and a			inable actolophicne, a	ina aney can prese
	una derena enebe opi		gambe the group.			
Personal Competence						
Social Competence	The students are able	e to discuss the vario	us technical and scien	tific tasks, both subject-	specific and multidiscip	olinary. They are a
	to develop different a	approaches to the tas	k as a group as well a	s to discuss their theore	tical or practical impler	mentation.
Autonomy	Students can indeper	ndently exploit source	es about of the subject	t, acquire the particular I	nowledge and tranfer	it to new problem
Workload in Hours	Independent Study Ti	Time 48. Study Time i	Lecture 42			
Credit points		inte 40, Study finite in				
Course achievement		Form	Description			
course acmevement	Yes None	Subject theoretic				
		practical work				
Examination	Written exam					
Examination duration and	1 hour					
scale						
Assignment for the	General Engineering	Science (German pro	gram, 7 semester): Sp	pecialisation Energy and	Enviromental Engineer	ing: Compulsory
Following Curricula	General Engineering	Science (German pro	gram, 7 semester): Sp	pecialisation Bioprocess I	Engineering: Elective C	ompulsory
	General Engineering	Science (German pro	gram, 7 semester): Sp	pecialisation Process Eng	ineering: Elective Com	pulsory
	Bioprocess Engineeri	ing: Core Qualification	: Elective Compulsory	/		
	En annual En danam	nental Engineering: C	ore Qualification: Com	pulsory		
	Energy and Environm	inentai Engineeringi e				
	3,	5 5	ram, 7 semester): Sp	ecialisation Bioprocess E	ngineering: Elective Co	ompulsory
	General Engineering	Science (English prog		ecialisation Bioprocess E ecialisation Energy and E		
	General Engineering	Science (English prog Science (English prog	ram, 7 semester): Sp		Enviromental Engineeri	ng: Compulsory

Course L1387: Practical Exer	rcise 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
	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: Environmenta	I Technologie		
Тур	Lecture		
Hrs/wk	2		
CP	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 		
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)		

Courses						
Title			1	ур	Hrs/wk	СР
Practical Course: Measurement and	d Control Systems (L1119)			ractical Course	2	2
Measurement Technology for Mech	anical Engineering (L1116)		L	ecture	2	3
Measurement Technology for Mech	anical Engineering (L1118)		F	ecitation Section (large)	1	1
Module Responsible	Prof. Thorsten Kern					
Admission Requirements	None					
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineering					
Knowledge						
Educational Objectives	After taking part success	fully, students have rea	ached the following	learning results		
Professional Competence						
Knowledge	Students are able to nar	ne the most important	fundmentals of th	e Measurement Technol	ogy (Quantities and	d Units, Uncertai
	Calibration, Static and D					
	-					
	They can outline the mo			erent kinds of quantities	s to be maesured (I	Electrical Quanti
	Temperature, mechanica	I quantities, Flow, I ime	e, Frequency).			
	They can describe import	tant methods of chemic	al Analysis (Gas S	ensors, Spectroscopy, Ga	s Chromatography)	
Skills	Students can select suita	ble measuring method:	s to given problem	s and can use refering m	easurement devices	s in practice.
	The shudents are able to	and the second also descended to		- f		
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well place the issues into the right context and application area.					
	place the issues into the	right context and appli	cation area.			
Personal Competence						
Social Competence	Students can arrive at we	ork results in groups an	d document them	n a common report.		
A		iliarize themselves with				
Autonomy	Students are able to fam		new measuremer	t technologies.		
				t technologies.		
Workload in Hours	Independent Study Time			t technologies.		
Workload in Hours Credit points	Independent Study Time 6	110, Study Time in Lec	ture 70	t technologies.		
Workload in Hours	Independent Study Time 6 Compulsory Bonus Fo	110, Study Time in Lec	ture 70 Description	t technologies.		
Workload in Hours Credit points	Independent Study Time 6 Compulsory Bonus For Yes None St	110, Study Time in Lec orm ubject theoretical a	ture 70	t technologies.		
Workload in Hours Credit points Course achievement	Independent Study Time 6 Compulsory Bonus For Yes None Si pu	110, Study Time in Lec	ture 70 Description	t technologies.		
Workload in Hours Credit points Course achievement Examination	Independent Study Time 6 Compulsory Bonus Fo Yes None Si pri Written exam	110, Study Time in Lec orm ubject theoretical a	ture 70 Description	t technologies.		
Workload in Hours Credit points Course achievement Examination	Independent Study Time 6 Compulsory Bonus Fo Yes None Si pri Written exam	110, Study Time in Lec orm ubject theoretical a	ture 70 Description	t technologies.		
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study Time 6 Compulsory Bonus Fr Yes None Si pr Written exam 105 minutes	110, Study Time in Lec mm ubject theoretical a ractical work	ture 70 Description and			
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus For Yes None Si pri Written exam 105 minutes General Engineering Scie	110, Study Time in Lec m ubject theoretical a ractical work ence (German program,	Description and 7 semester): Spec	ialisation Mechanical Eng		
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study Time 6 Compulsory Bonus Fc Yes None Si pr Written exam 105 minutes General Engineering Scie General Engineering Scie	110, Study Time in Lec mubject theoretical a ractical work ence (German program, ence (German program,	T semester): Spec 7 semester): Spec	ialisation Mechanical Eng	gineering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus For Yes None Si pri Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie	110, Study Time in Lec mulject theoretical a ractical work ence (German program, ence (German program,	T semester): Spec 7 semester): Spec 7 semester): Spec 7 semester): Spec	ialisation Mechanical Eng	gineering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus For Yes None Si pri Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie Digital Mechanical Engine	110, Study Time in Lec mulpiect theoretical a ractical work ence (German program, ence (German program, ence (German program, ence (German program,	7 semester): Spec 7 semester): Spec 7 semester): Spec 7 semester): Spec 7 semester): Spec	ialisation Mechanical Eng ialisation Biomedical Eng ialisation Energy and Eng	gineering: Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus Fa Yes None Si pri Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie Digital Mechanical Engine	110, Study Time in Lec mulpiect theoretical a ractical work ence (German program, ence (German program, ence (German program, eering: Core Qualification al Engineering: Core Qu	7 semester): Spec 7 semester): Spec 7 semester): Spec 7 semester): Spec 7 semester): Spec on: Compulsory Jalification: Compu	ialisation Mechanical Eng ialisation Biomedical Eng ialisation Energy and Eng	gineering: Compulso	ry
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Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus Fa Yes None Si pri Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie Digital Mechanical Engine	110, Study Time in Lec mubject theoretical a ractical work ence (German program, ence (German program, ence (German program, ence (German program, eering: Core Qualification al Engineering: Core Qualification ecialisation Mechanical	Topological contraction of the section of the secti	ialisation Mechanical Eng ialisation Biomedical Eng ialisation Energy and En Isory	gineering: Compulso	ry
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Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus Fa Yes None Su priving Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie Digital Mechanical Engine Engineering Science: Spe Engineering Science: Spe Engineering Science: Spe General Engineering Scie General Engineering Scie General Engineering Scie General Engineering Scie General Engineering Scie General Engineering Scie General Engineering Scie	110, Study Time in Lec mubject theoretical a ractical work ence (German program, ence (German program, ence (German program, ence (German program, ence (German program, ecilisation Mechanical ecialisation Mechanical ecialisation Mechanical ecialisation Biomedical I ence (English program, ence (English program, ence (English program, ence (English program, ence (English program, ence (English program,	Description and 7 semester): Spec 7 semester): Spec 7 semester): Spec 7 semester): Spec 9 semester): Spec 9 semester): Spec 7 semester): Spec	ialisation Mechanical Eng ialisation Biomedical Eng ialisation Energy and En lsory ve Compulsory alisation Energy and Env alisation Mechanical Eng alisation Mechatronics: C alisation Mechanical Eng	jineering: Compulso viromental Engineer ineering: Compulsor ineering: Compulsor compulsory ineering: Compulsor ineering: Compulsor	rry 'ing: Compulsory ng: Compulsory ry 'y ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus Fa Yes None Su priving Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie Digital Mechanical Engine Engineering Science: Spe Engineering Science: Spe Engineering Science: Spe General Engineering Scie General Engineering Scie	110, Study Time in Lec mubject theoretical a ractical work ence (German program, ence (English program,	The semester of the second sec	ialisation Mechanical Eng ialisation Biomedical Eng ialisation Energy and En lsory ve Compulsory alisation Energy and Env alisation Mechanical Eng alisation Mechatronics: C alisation Mechanical Eng	jineering: Compulso viromental Engineer ineering: Compulsor ineering: Compulsor compulsory ineering: Compulsor ineering: Compulsor	rry 'ing: Compulsory ng: Compulsory ry 'y ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 6 Compulsory Bonus For Yes None Study Written exam 105 minutes General Engineering Scie General Engineering Scie General Engineering Scie Digital Mechanical Engine Engineering Science: Spe Engineering Science: Spe General Engineering Scie General Engineering Scie	110, Study Time in Lec mubject theoretical a ractical work ence (German program, ence (English program,	The semester of the second sec	ialisation Mechanical Eng ialisation Biomedical Eng ialisation Energy and En lsory ulsory ve Compulsory alisation Energy and Env alisation Mechanical Eng alisation Mechatronics: C alisation Mechanical Eng	jineering: Compulso viromental Engineer ineering: Compulsor ineering: Compulsor compulsory ineering: Compulsor ineering: Compulsor	rry 'ing: Compulsory ng: Compulsory ry 'y ry

	Practical Course
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseo pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine v be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications wi 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 am Arbeitsplatz. 2. Auf Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbu Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltur Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 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 Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

Course L1116: Measurement	Technology for Mechanical Engineering			
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
	Prof. Thorsten Kern, Dennis Kähler			
Language				
Cycle				
Content	1 Fundamentals			
	1.1 Quantities and Units			
	1.2 Uncertainty			
	1.3 Calibration			
	1.4 Static and Dynamic Properties of Sensors and Systems			
	2 Measurement of Electrical Quantities			
	2.1 Current and Voltage			
	2.2 Impedance			
	2.3 Amplification			
	2.4 Oscilloscope			
	2.5 Analog-to-Digital Conversion			
	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			
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3.			
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.			

Course L1118: Measurement	ourse L1118: Measurement Technology for Mechanical Engineering		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	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		

Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements				
	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll-	owing loarning results		
	After taking part successiony, students have reached the for	owing learning results		
Professional Competence Knowledge				
	 The students are capable of explaining qualitative and heat exchanger, chemical reactors). They are capable of distinguish and characterize differ transfer and thermal radiation. The students have the ability to explain the physic qualitative and quantitative by using suitable mass transfer are able to depict the analogy between heat- and 	rent kinds of heat transfer mech cal basis for mass transfer in c ansfer theories.	anisms namely h letail and to de	neat conduction, h
Skills	 The students are able to set reasonable system boundaries for a given transport problem by using the gained knowled and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluid and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowled for the description and design of apparatus (e.g. extraction column, rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a speciapplication considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete techni problems. 			
Personal Competence Social Competence				orally in a reasona
Autonomy	 The students are able to find and evaluate necessary i They are able to prove their level of knowledge dur system, exam-like assignments) and on this basis they 	ring the course with accompany	ing procedure o	continuously (click
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes; theoretical questions and calculations			
scale				
Assignment for the	General Engineering Science (German program, 7 semester):	Specialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester):	: Specialisation Bioprocess Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 semester):	: Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	General Engineering Science (German program, 7 semester):	Specialisation Green Technolog	es: Compulsory	
	Bioprocess Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification: C	ompulsory		
	General Engineering Science (English program, 7 semester):	Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semester):	Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 semester):	Specialisation Process Engineering	ng: Compulsory	
	Technomethemetics, Creciplication III, Engineering Colonge, J	Elective Compulsory		
	Technomathematics: Specialisation III. Engineering Science: I	Elective compaisory		

Course L0101: Heat and Mas	s Transfer		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	ndependent 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 Mas	Course L0102: Heat and Mass Transfer		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Irina Smirnova		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

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

-				
Courses				
Title	10)	Тур	Hrs/wk	СР
Thermal Separation Processes (L01		Lecture Recitation Section (small)	2	2
Thermal Separation Processes (L01 Thermal Separation Processes (L01		Recitation Section (small) Recitation Section (large)	2	2
Separation Processes (L1159)	≠±)	Practical Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements				
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	• The students can distinguish and describe d	ifferent types of separation processes	such as distillat	tion extraction a
	adsorption		Such as also	
	• The students develop an understanding for th	e course of concentration during a sepa	aration process. I	the estimation of
	energy demand of a process, the possibilities of			
	 They have good knowledge of designing method 		-	
Skills	Using the gained knowledge the students can	select a reasonable system boundary fo	r a given senara	tion process and
	close the associated energy and material bala		i a given separa	cion process and
	 The students can use different graphical me 		n process and d	efine the amount
	theoretical stages required	alous for the designing of a separation	i process and a	enne the amoun
	 They can select and design a basic type of 	hermal separation process for a given	case based on	the advantages
	disadvantages of the process	inernial separation process for a given	cuse bused on	the advantages
	 The students are capable to obtain independe 	ntly the needed material properties from	n annronriate so	urces (diagrams
	tables)	nity the needed material properties not	ii appropriate se	urces (ulugranis
	 They can calculate continuous and discontinuo 			
	 The students are able to prove their theoretica 		k	
	 The students are able to prove their theoretica The students are able to discuss the theoretic 			with the teacher
	colloquium.	a background and the content of the ex	perimental work	with the teacher.
	conoquium.			
	The students are capable of linking their gained know	ledge with the content of other lectures	and use it togeth	ner for the solutior
	technical problems. Other lectures such as thermody	namics, fluid mechanics and chemical er	igineering.	
Personal Competence				
Social Competence	• The students can work technical assignments i	n small groups and present the combine	d results in the t	utorial
	······································	5		
	The students are able to carry out practical la	ab work in small groups and organize a	functional divisi	ion of labor betw
	them. They are able to discuss their results an			
	,			
Autonomy	The students are capable to obtain the needed	information from suitable sources by th	ameelyos and as	cace thair quality
	 The students are capable to obtain the needed The students can proof the state of their kr 			
	 The students can proof the state of their ki learning process 	lowledge with exam resembling assign		iis way control u
	learning process			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	1		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes; theoretical questions and calculations			
scale				
-	General Engineering Science (German program, 7 ser			
Following Curricula	General Engineering Science (German program, 7 ser	nester): Specialisation Bioprocess Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 ser	nester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	Bioprocess Engineering: Core Qualification: Compulse	•		
	Energy and Environmental Engineering: Core Qualific	ation: Compulsory		
	General Engineering Science (English program, 7 ser	ester): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 ser	ester): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 sem	ester): Specialisation Process Engineeri	ng: Compulsory	
	Process Engineering: Core Qualification: Compulsory			

avT	Lecture			
Hrs/wk				
CP				
-	- ndependent Study Time 32, Study Time in Lecture 28			
	Prof. Irina Smirnova			
Language				
Cycle				
Content				
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 separat 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 Yor 			

ourse L0119: Thermal Sepa	ration Processes			
Тур	Recitation Section (small)			
Hrs/wk	2			
CP	2			
Workload in Hours	dependent 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 			

rse L0141: Thermal Sepa	
Тур	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	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 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 separati 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 198 Ullmann"s Enzyklopädie der Technischen Chemie

Course L1159: Separation Pr	ocesses
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They
	receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course:
	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation 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

Courses						
Fitle			Тур	Hrs/wk	СР	
Gas and Steam Power Plants (L020	6)		Lecture	3	5	
Gas and Steam Power Plants (L021			Recitation Section (large)	1	1	
Module Responsible	NN					
Admission Requirements	None					
Recommended Previous	None					
Knowledge	 "Technical The 	ermodynamics I and II"				
Riomeuge	 "Heat Transfe 	r"				
	 "Fluid Mechan 	nics"				
Educational Objectives	After telding part aug	essefully, students have	reached the following learning require			
Educational Objectives	After taking part suc	cessiuny, students have	reached the following learning results			
Professional Competence						
Knowledge			t of the electricity demand and the energy			
	-		ant and the layout of the steam generator b	-		
			nt. Additionally they can describe the ex			
			ssil-fuelled power plants with solar therma	l and geothermal po	ower plants or pla	
	equipped with Carbo	on Capture and Storage.				
	The students have b	asic knowledge about th	e principles, operation and design of turbom	achinerv		
Skills	The students will be	e able, using theories a	nd methods of the energy technology from	n fossil fuels and ba	ased on well-foun	
	knowledge on the fu	nction and construction	of gas and steam power plants, to identify b	asic associations in t	he production of h	
	and electricity, so a	s to develop conceptual	solutions. Through analysis of the problem	n and exposure to t	nd exposure to the inherent interp	
	between heat and power generation the students are endowed with the capability and methodology to develop realistic optimal					
	concepts for the ger	neration of electricity and	the production of heat. From the technical	basics the students	become the ability	
	follow better the del	iberations on the electric	city mix composition within the energy-politi	ical triangle (econom	ny, secure supply	
	environmental prote	ction).				
	Within the framewor	k of the exercise the stu	dents learn the use of the specialised softwa	re suite EBSILON Pro	ofessional ^{IM} . With	
	tool small practical t	asks are solved with the	PC, to highlight aspects of the design and de	evelopment of power	nt of power plant cycles.	
	The students are ab	le to do simplified calcu	lations on turbomachinery either as part of	a plant as single co	omponent or at st	
	The students are able to do simplified calculations on turbomachinery either as part of a plant, as single component or at sta level.					
	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 dire					
	contact with a mode	ern power plant in this r	egion. The students will obtain first-hand ex	perience with a pov	ver plant in operat	
	and gain insights int	o the conflicts between t	echnical and political issues.			
Autonomy	The students assiste	d by the tutors will be at	ole to develop alone simple simulation model	s and run with these	e scenario analyses	
			nowledge from the lecture is consolidated			
			ions highlighted. The students are able ir			
	performance of stea	m power plants and calc	ulate selected quantities and characteristic o	urves.		
Workload in Hours		Time 124, Study Time in	Lecture 56			
Credit points Course achievement	o Compulsory Bonus	Form	Description			
course achievement	No 5 %	Excercises	10 Übungsaufgaben im Laufe der Vorl	esungen à 5 Minuter	n; bis zu 5 % Bonu	
			nach Anteil richtiger Abgaben			
	No 5 %	Attestation	15-minütiges, unbenotetes Testal	über FBSILON	Professional	
		, leebearion	bestanden/nicht bestanden (keine ant		i i oressional,	
Examination	Written exam		Sestanden, nene bestanden (kenne und			
Examination duration and		of 120 min				
scale	Whiten examination	01 120 1111				
	Conoral Engineering	- Ecianco (Cormon pro	aram 7 competers Specialization Energy	and Environmental	Engineering, Elec	
-		Julence (German pro	gram, 7 semester): Specialisation Energy		Engineering: Elect	
Following Curricula	Compulsory	Composition Composition	Tram 7 competer), Cresislication Marthan	col Engineering 5-	cue Enoreu Cu-t-	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus				cus Energy Syste	
	Elective Compulsory		Qualification, Floating Commutation			
			Qualification: Elective Compulsory			
			Course Core Studies: Elective Compulsory			
		g Science (English prog	gram, 7 semester): Specialisation Energy	and Enviromental	Engineering: Elec	
Compulsory						
			ram, 7 semester): Specialisation Mechanic	cal Engineering, Foo	cus Energy Syste	
	Elective Compulson					
	Elective Compulsory					

Course L0206: Gas and Stea	m Power Plants			
Тур	Lecture			
Hrs/wk	3			
CP	5			
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42			
Lecturer	Prof. Alfons Kather			
Language	E			
Cycle	ViSe			
Content	In the 1 st part of the lecture an overview on thermal power plants is offered, including:			
	Electricity demand and Forecasting Thermodynamic fundamentals			
	Thermodynamic fundamentals Energy Conversion in thermal power plants			
	Types of power plant			
	Layout of the power plant block			
	Individual elements of the power plant			
	Cooling systems			
	Flue gas cleaning			
	Operation characteristics of the power plant			
	Construction materials for power plants			
	Location of power plants			
	Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.			
	These are complemented in the 2 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			
	Characteristic numbers			
	Axial and radial design			
	Design features			
	Hydraulic turbomachines			
	Pump and water turbine designs			
	Design examples of reciprocating engines and turbomachinery			
	Steam power plants			
	Gas turbine systems.			
Literature				
	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			

ourse L0210: Gas and Stear	n Power Plants
Тур	Recitation Section (large)
Hrs/wk	
CP	1
	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 plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	 Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO_2 emissions and the resulting climatic effects are a special focus
	the lecture and the lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants a renewable energy sources are discussed and the technical options for providing security of supply and network stability a presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's or actions are emphasized and the potential extent of the different solutions presented clearly.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM . With tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The stude present their results orally and can afterwards ask questions and get feedback. The course work has a positive effect on the students final grade.
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, Heizkraftwerke u
	Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (L0	235)	Lecture	2	3
Computational Fluid Dynamics I (LO	419)	Recitation Section (lar	rge) 2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mathematical Methods for Enginee			
	 Fundamentals of Differential/integ 	rai calculus and series expansions		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students are able to list the basic nu	merics of partial differential equations.		
Skills	The students are able develop appropriate	te numerical integration in space and time fo	or the governing partial of	differential equation
	They can code computational algorithms	in a structured way.		
Personal Competence				
	The students can arrive at work results in	around and document them		
Social Competence	The students can arrive at work results in	groups and document them.		
A	The students are independently each as			
Autonomy	The students can independently analyse	approaches to solving specific problems.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Energy ar	nd Enviromental Enginee	ering: Compulsory
Following Curricula	General Engineering Science (German pr	ogram, 7 semester): Specialisation Naval Arc	hitecture: Compulsory	
	General Engineering Science (German	program, 7 semester): Specialisation Mech	nanical Engineering, Foo	cus Energy System
	Elective Compulsory			
		program, 7 semester): Specialisation Mech	anical Engineering, Foo	cus Energy System
	Compulsory			
		program, 7 semester): Specialisation Ener	gy and Enviromental I	Engineering: Elect
	Compulsory	anna 7 competer). Crociplication Machania	al Engineering Facus T	heerstical Machan
	Engineering: Elective Compulsory	ogram, 7 semester): Specialisation Mechanic	.ai Engineering, Focus II	neoretical Mechan
		ary Course Core Studies: Elective Compulsory	/	
		program, 7 semester): Specialisation Ener		Engineering: Fled
	Compulsory		5, and Environmental I	
		gram, 7 semester): Specialisation Energy an	d Enviromental Engineer	ring: Compulsorv
		program, 7 semester): Specialisation Mech		
	Elective Compulsory			5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5
		gram, 7 semester): Specialisation Naval Arch	nitecture: Compulsory	
	Mechanical Engineering: Specialisation E	aaray Systems, Elective Compulsory		
	Meenanical Engineering. Specialisation E	nergy systems. Elective compulsory		
	Naval Architecture: Core Qualification: Co			

Course L0235: Computationa	al Fluid Dynamics I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	 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

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

Module M0670: Partic	le Techn	ology	and Solids Proce	ess Engineer	ing		
Courses							
Title					Тур	Hrs/wk	СР
Particle Technology I (L0434)					Lecture	2	3
Particle Technology I (L0435)					Recitation Section (small)	1	1
Particle Technology I (L0440)	1				Practical Course	2	2
Module Responsible	Prof. Stefan	Heinrich					
Admission Requirements	None						
Recommended Previous	keine						
Knowledge							
Educational Objectives	After taking	part succ	essfully, students have	reached the follow	ing learning results		
Professional Competence							
Knowledge	After succes	sful comp	letion of the module stu	idents are able to			
	• namo	and oval	ain processes and unit-	oporations of solid	c process opginoering		
			articles, particle distribut				
	• chara	cterize pe	inticles, particle distribu		is their buik properties		
	c						
SKIIIS	Students are	e able to					
	 choos 	e and des	sign apparatuses and pr	ocesses for solids	processing according to the o	lesired solids prop	erties of the produ
	 asses 	solids wit	th respect to their behave	vior in solids proce	ssing steps		
	 docun 	 document their work scientifically. 					
Personal Competence							
Social Competence				topics orally with	other students or scientific	personal and to o	develop solutions f
			ues in a group.				
Autonomy	Students are	e able to a	analyze and solve quest	ions regarding soli	d particles independently.		
Workload in Hours	Independent	: Study Ti	me 110, Study Time in I	_ecture 70			
Credit points	6						
Course achievement	Compulsory B		Form	Description			
	Yes N	lone	Written elaboration	sechs Berich	nte (pro Versuch ein Bericht)	à 5-10 Seiten	
Examination	Written exar	n					
Examination duration and	90 minutes						
scale							
Assignment for the	General Engi	ineering S	Science (German progra	m, 7 semester): S	pecialisation Process Enginee	ring: Compulsory	
Following Curricula	General Engi	ineering S	Science (German progra	m, 7 semester): S	pecialisation Bioprocess Engi	neering: Compulso	ory
	General Engi	ineering S	Science (German progra	m, 7 semester): S	pecialisation Energy and Envi	romental Enginee	ring: Compulsory
	Bioprocess E	ngineerir	ng: Core Qualification: C	ompulsory			
	Energy and B	Environm	ental Engineering: Core	Qualification: Com	npulsory		
	General Eng	ineering S	Science (English program	n, 7 semester): Sp	ecialisation Bioprocess Engin	eering: Compulso	ry
	General Eng	ineering S	Science (English program	n, 7 semester): Sp	ecialisation Energy and Envir	omental Engineer	ing: Compulsory
	General Eng	ineering S	Science (English program	n, 7 semester): Sp	ecialisation Process Engineer	ing: Compulsory	
	_		Core Qualification: Com		-		

Course L0434: Particle Techr	nology I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 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 Tech	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 Tech	nology I
Тур	Practical Course
Hrs/wk	2
CP	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		Тур	Hrs/wk	СР	
Informatics for Process Engineers (L0836)	Lecture	2	2	
Informatics for Process Engineers (L0837)	Recitation Section (small)	2	2	
Numeric and Matlab (L0125)		Practical Course	2	2	
Module Responsible	Dr. Marcus Venzke				
Admission Requirements	None				
Recommended Previous	Basic knowledge in using MS Windows.				
Knowledge					
Educational Objectives	After taking part successfully, students have read	ched the following learning results			
Professional Competence					
Knowledge	Students can describe procedural and object-orie	nted concepts.			
Skills	Students are capable of object-oriented programming in the programing language Java and of solving mathematic questions 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 app	blying it in practice.			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Energy an	d Enviromental E	Engineering: Electiv	
Following Curricula					
	General Engineering Science (German program,	7 semester): Specialisation Process Enginee	ring: Elective Con	npulsory	
	Bioprocess Engineering: Core Qualification: Comp	oulsory			
	Energy and Environmental Engineering: Core Qua	alification: Compulsory			
	General Engineering Science (English program	, 7 semester): Specialisation Energy and	d Enviromental E	Engineering: Electiv	
	Compulsory				
	compaisory				
	General Engineering Science (English program, 7	semester): Specialisation Process Engineer	ing: Elective Com	pulsory	

urse L0836: Informatics fo	r 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, Massachuset 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 fo	r Process Engineers
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
Content	In the lab, the content from the lecture is practiced and deepened with practical assignments. Every week one or two programming tasks are assigned. These are solved by the students on computers independently, coached by a tutor.
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/

Course L0125: Numeric and	Matlab
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 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): Moler, C., Numerical Computing with MATLAB, SIAM, 2004 The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Courses						
Title			Тур	Hrs/wk	СР	
Process and Plant Engineering I (LC	0095)		Lecture	2	2	
Process and Plant Engineering I (LC			Recitation Section (large)	1	2	
Process and Plant Engineering I (L1			Recitation Section (small)	1	2	
Module Responsible		ki				
Admission Requirements	None					
Recommended Previous	unit operation of therr	mal an dmechanical separatio	n processes			
Knowledge	chemical reactor eing	ineering				
	After taking part aver	eestullu, studente beue veesbe	d the following logging regults			
Educational Objectives	After taking part succ	essituliy, students have reache	d the following learning results			
Professional Competence	students can:					
Knowledge	students can.					
	classify and formulate	blobal balance equations of o	hemical processes			
	specify linear compon	ent equations of complex che	mical processes			
	explain linear regressi	ion and data reconcilliation pr	oblems			
	explain pfd-diagrams					
Skills	s students are capable of					
	- formulation of mass	and energy balance equations	and estimation of product streams			
	- estimation of component streams of chemical plants using linear component balance models					
	- solution of data reconcilliation tasks					
	- conduction of process synthesis					
	- economic evaluation of processes and the estimation of production costs					
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Tir	me 124, Study Time in Lecture	56			
Credit points	6					
Course achievement	Compulsory Bonus		Description			
	Yes 10 %	Subject theoretical and practical work				
Examination	Written exam					
Examination duration and		and backs				
examination duration and scale	120 Min. reclures note					
	General Engineering	Science (German program 7 s	emester): Specialisation Process Enginee	ring: Compulsory		
			emester): Specialisation Bioprocess Engli		arv	
r onowing curriculu			7 semester): Specialisation Energy ar			
	Compulsory					
		g: Core Qualification: Comput	sory			
		- ,	mester): Specialisation Bioprocess Engir	neering: Compulso	ry	
			7 semester): Specialisation Energy an			
	Compulsory					
		Science (English program, 7 se	mester): Specialisation Process Engineer	ring: Compulsory		
		Core Qualification: Compulsor				

Course L0095: Process and Plant Engineering I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mirko Skiborowski	
Language	DE	
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
	3. Process Synthesis Decision levels
	Experimental process development
	Reactor synthesis
	Synthesis of separation processes (process alternatives and criteria for selection)
	Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety
	5. Cost estimation of production plants
	Production costs, capital costs, economic evaluation
Literature	
	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
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	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
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	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
	G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306
	G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213
	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
	T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
	J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
	J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511
	K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
	S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169
	J. Mittelstraß, ChemIngTech. 66(1994), S. 309
	P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
	G. Kaibel, Dissertation, TU München, 1987
	G. Kaibel, ChemIngTech. 61 (1989), Nr. 2, S. 104-112
	G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
	H.J. Lang, Chem. Eng. 54(10),117, 1947
	H.J. Lang, Chem. Eng. 55(6), 112, 1948
	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process and Plant Engineering I	
Тур	Recitation Section (large)
Hrs/wk	1
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

Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biolog	У		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence		and a standard to an a standard of the standard		
Knowedge	With the completion of this module the students ac environmental problems which might occur from produ about the methodological diversity and are competent i impacts. Besides the students are able to estimate the	ction processes, projects or construc n dealing with different methods and	tion measures.	They have knowled assess environmen
	difficulties with their measurement.			
Skills	The students are able to select a suitable method for th	ne respective case from the variety o	f assessment m	ethods. Thereby th
	can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to car out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Econver After finishing the course the students have the competence to critically judge research results or other publications of environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technical are to develop jointly different solutions and to discuss the topics, the students receive insights into the multi-layer. Their sensitivity and consciousness towards these sub social responsibilities in their role as engineers.	eir theoretical or practical impleme ed issues of the environment protect	ntation. Due to ion and the con	the selected lectuce cept of sustainabili
Autonomy	The students learn to research, process and present scientific work. They can solve an environmental problem			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Energy and Envir	omental Enginee	ering: Compulsory
Following Curricula	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 seme Bioprocess Engineering: Core Qualification: Elective Con Energy and Environmental Engineering: Core Qualification	ster): Specialisation Process Engineer npulsory		
	General Engineering Science (English program, 7 semes General Engineering Science (English program, 7 semes General Engineering Science (English program, 7 semes Process Engineering: Core Qualification: Elective Compu	ter): Specialisation Bioprocess Engine ter): Specialisation Energy and Enviro ter): Specialisation Process Engineerii	mental Enginee	ring: Compulsory

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

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

Specialization Computer Science

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

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

Module M0561: Discr	ete Algebraic Structures			
Courses				
Title		Тур	Hrs/wk	СР
Discrete Algebraic Structures (L01	54)	Lecture	2	3
Discrete Algebraic Structures (L01	65)	Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Mathematics from High School.			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students know the important basics of discrete algebraic structures including elementary combinatorial structures, monoids groups, rings, fields, finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete algebraic structures.			
Personal Competence				
Social Competence	Students are able to solve specific problems	alone or in a group and to present the result	s accordingly.	
Autonomy	Students are able to acquire new knowledge from specific standard books and to associate the acquired knowledge to othe classes.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Computer Sc	ience: Compulsory	
Following Curricula	Computer Science: Core Qualification: Comp	ulsory		
	General Engineering Science (English progra	m, 7 semester): Specialisation Computer Scie	ence: Compulsory	
	Computational Science and Engineering: Cor	e Qualification: Compulsory		
	Orientierungsstudium: Core Qualification: Ele	ective Compulsory		
	Technomathematics: Specialisation I. Mather	matics: Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence Knowledge	This module deals with the foundations of the fund	tionality of computing systems. It cover	s the layors from	a the accomply lo
Knowledge	programming down to gates. The module includes th		s the layers non	in the assembly-les
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks			works
	 Sequential logic: Flip-flops, automata, system Technological foundations 	atic hardware design		
	 Technological foundations Computer arithmetic: Integer addition, subtra 	ction multiplication and division		
	Basics of computer architecture: Programmin		pipelining	
	 Memories: Memory hierarchies, SRAM, DRAM, 			
	Input/output: I/O from the perspective of the	CPU, principles of passing data, point-to-p	oint connections,	busses
Ckille	The students perceive computer systems from the s	rchitect's perspective i.e. they identify t	ha internal struct	ture and the physic
JKIIIS	The students perceive computer systems from the a composition of computer systems. The students car			
	collection of few and simple components. They are			
	today's computing systems - from gates and circuits			,
	After successful completion of the medule the stu	dante que able te judes the interdenced	ancies between	
	After successful completion of the module, the stu system and the software executed on it. In particula			
	on the hardware-centric abstraction layers from the			
	the impact that these low abstraction levels have or			
	- F			
Personal Competence				
Social Competence	Students are able to solve similar problems alone or	in a group and to present the results acc	ordingly.	
Autonomy	Students are able to acquire new knowledge from sp	pecific literature and to associate this kno	wledge with othe	r classes.
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		Description		
	Yes 10 % Excercises			
Examination	Written exam			
Examination duration and	90 minutes, contents of course and labs			
scale				
	General Engineering Science (German program, 7 se			
Following Curricula				ory
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	•		
	General Engineering Science (German program, 7 se			1
General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering:		2		
	General Engineering Science (German program, 7 se		-	5 . ,
		emester): Specialisation Process Engineer	ing. compulsory	
	General Engineering Science (German program,			Focus Mechatroni
	General Engineering Science (German program, Compulsory			Focus Mechatroni
		7 semester): Specialisation Mechanica	I Engineering, I	
	Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation Mechanica7 semester): Specialisation Mechanica	I Engineering, I I Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanica7 semester): Specialisation Mechanica	I Engineering, I I Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical	I Engineering, I I Engineering, F Engineering, Foc	ocus Biomechani us Aircraft Syste
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 science)	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica	I Engineering, I I Engineering, F Engineering, Foc	ocus Biomechani us Aircraft System Focus Materials
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 sc Engineering: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Mechanical Engin	I Engineering, I I Engineering, F Engineering, Foc al Engineering, neering, Focus Th	iocus Biomechani us Aircraft Syste Focus Materials teoretical Mechani
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 science)	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Mechanical Engin	I Engineering, I I Engineering, F Engineering, Foc al Engineering, neering, Focus Th	iocus Biomechani us Aircraft Syste Focus Materials teoretical Mechani
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 sc Engineering: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	I Engineering, I I Engineering, Foc Engineering, Foc al Engineering, neering, Focus P ineering, Focus P	iocus Biomechani uus Aircraft Syste Focus Materials neoretical Mechani Product Developme
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 sc Engineering: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	I Engineering, I I Engineering, Foc Engineering, Foc al Engineering, neering, Focus P ineering, Focus P	iocus Biomechani uus Aircraft Syster Focus Materials neoretical Mechani Product Developme
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 sc Engineering: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	I Engineering, I I Engineering, Foc Engineering, Foc al Engineering, neering, Focus P ineering, Focus P	iocus Biomechani uus Aircraft Syster Focus Materials neoretical Mechani Product Developme
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 sc Engineering: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory Compulsory Computer Science: Core Qualification: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engli remester): Specialisation Mechanical Engli remester): Specialisation Mechanical Engli remester): Specialisation Mechanical Engli	I Engineering, I Engineering, Foc al Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc	iocus Biomechani uus Aircraft Syster Focus Materials neoretical Mechani Product Developme
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 sc Engineering: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 sc and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine ry mester): Specialisation Mechanical Engine ry	I Engineering, I Engineering, Foc al Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc	iocus Biomechani us Aircraft Syste Focus Materials neoretical Mechani rroduct Developmu us Energy Syster
	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 st Engineering: Compulsory General Engineering Science (German program, 7 st and Production: Compulsory General Engineering Science (German program, 7 st and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsor General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine ry mester): Specialisation Computer Science mester): Specialisation Bioprocess Engine	I Engineering, I Engineering, Foc al Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc : Compulsory ering: Compulsor	Focus Biomechani Eus Aircraft Syster Focus Materials Recoretical Mechani Product Developme us Energy System
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	Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 st Engineering: Compulsory General Engineering Science (German program, 7 st and Production: Compulsory General Engineering Science (German program, 7 st and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine remester): Specialisation Mechanical Engine rester): Specialisation Mechanical Engine rester): Specialisation Mechanical Engine mester): Specialisation Mechanical Engine mester): Specialisation Mechanical Engine mester): Specialisation Mechanical Engine mester): Specialisation Computer Science mester): Specialisation Naval Architecture mester): Specialisation Civil Engineering: mester): Specialisation Electrical Engineering	I Engineering, I Engineering, Foc Engineering, Foc al Engineering, Foc al Engineering, Focus Th ineering, Focus P Engineering, Foc Engineering, Foc Engineering, Foc Compulsory Compulsory ring: Compulsory ring: Compulsory	Focus Biomechani Lus Aircraft Syster Focus Materials Recoretical Mechani Product Developme us Energy System

	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
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
5	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
ā	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
	Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
r	Mechatronics: Core Qualification: Compulsory
۲ ا	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	jineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 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 Eng	Course L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses						
Title		Тур	Hrs/wk	СР		
Objectoriented Programming, Algorithms and Data Structures (L0131) Objectoriented Programming, Algorithms and Data Structures (L0132)		Lecture	4	4		
		Recitation Section (small)	1	2		
Module Responsible	Prof. Rolf-Rainer Grigat					
Admission Requirements	None					
Recommended Previous	This lecture requires proficiency in the German	This lecture requires proficiency in the German language. For further requirements please refer to the German description.				
Knowledge						
Educational Objectives	After taking part successfully, students have rea	ached the following learning results				
Professional Competence						
Knowledge	Students can explain the essentials of software design and the design of a class architecture with reference to existing libraries and design patterns.					
	Students can describe fundamental data structu sorting and searching.	ires of discrete mathematics and assess the o	complexity of imp	oortant algorithms f		
Skills	Students are able to Design software using given design patte 	rns and applying class hierarchies and polym	orphism			
	 Carry out software development and test Sort and search for data efficiently Assess the complexity of algorithms. 	s using version management systems and Go	ogle Test			
Personal Competence						
	Students can work in teams and communicate i	n forums.				
Autonomy	Students are able to solve programming tasks s and over a period of two to three weeks.	uch as LZW data compression using SVN Rep	ository and Goog	le Test independer		
Workload in Hours	Independent Study Time 110, Study Time in Leo	ture 70				
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and scale	60 Minutes, Content of Lecture, exercises and m	naterial in StudIP				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Computer Science	e: Compulsory			
Following Curricula	Computer Science: Core Qualification: Compulse	bry				
	Electrical Engineering: Core Qualification: Comp	ulsory				
	General Engineering Science (English program,		e: Compulsory			
	Logistics and Mobility: Specialisation Engineerin					
	Orientierungsstudium: Core Qualification: Election	ve Compulsory				

Course L0131: Objectoriente	d Programming, Algorithms and Data Structures
Тур	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Rolf-Rainer Grigat
Language	DE
Cycle	SoSe
Content	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: Objectoriente	d Programming, Algorithms and Data Structures
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Rolf-Rainer Grigat
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Courses				
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4
Signals and Systems (L0432)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge				
-	The modul is an introduction to the theory of signals a		-	
	1-3 is expected. Further experience with spectral tran	isformations (Fourier series, Fourier tr	ansform, Laplace	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals	and linear time-invariant (LTI) systems	s using methods (of signal and syste
	theory. They are able to apply the fundamental trans	formations of continuous-time and dis	crete-time signals	s and systems. Th
	can describe and analyse deterministic signals and s	ystems mathematically in both time a	ind image domai	n. In particular, th
	understand the effects in time domain and image do	main which are caused by the trans	tion of a continu	ous-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determ	inistic signals and linear time-invariant	systems using m	nethods of signal a
	system theory. They can analyse and design basic			
	response, stability, linearity etc They can assess the	mpact of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence				
	The students can jointly solve specific problems.		_	
Autonomy	The students are able to acquire relevant information			ontrol their level
	knowledge during the lecture period by solving tutoria		em.	
	Independent Study Time 110, Study Time in Lecture 7)		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	90 min			
scale				
	General Engineering Science (German program, 7 sem			1
Following Curricula	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	i Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program, 7 s	emester): Specialisation Mechanical	Engineering Foc	us Energy System
	Compulsory	semester). Specialisation mechanical	Lingineering, Toe	us Energy System
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Aircraft System
	Engineering: Compulsory		,,,,,,,,,,,,,,,,,,,,,,	
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory		5 5.	
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	al Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Bioprocess Engine	ering: Compulsor	гу
	General Engineering Science (English program, 7 seme	ester): Specialisation Biomedical Engine	ering: Compulso	ry
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syster
	Engineering: Compulsory	anton). Consciolization March 1975	and the state	teriele in En 1
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engin	eering, Focus Mat	leriais in Engineeri
	Sciences: Compulsory	comostor), Crossielization March	Engineering	Focus Masteria '
	General Engineering Science (English program, 7 Compulsory	semester): specialisation Mechanica	ii Engineering, I	-ocus Mechatroni
	Compulsory	ester). Specialisation Mochanical Fast	peering Ecour Th	enetical Machani
	General Engineering Science (English program, 7 sem Engineering: Compulsory	ester, specialisation mechanical Engli	icening, rocus In	
	Computational Science and Engineering: Core Qualifica	ation: Compulsory		
	comparational science and Engineering. Core Qualifica	compaisory		
	Mechatronics: Core Qualification: Compulsory			

Course L0432: Signals and S	vstems
Тур	
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	
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 and S	ourse 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		Typ	Hrs/wk	СР
Graph Theory and Optimization (L1	046)	Typ Lecture	нгs/wк 2	3
Graph Theory and Optimization (L1		Recitation Section (small)	2	3
Module Responsible				
	None			
Recommended Previous				
Knowledge	Discrete Algebraic Structures			
laioniougo	Mathematics I			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
	Arter taking part successionly, students have reached	a the following learning results		
Professional Competence				
Knowledge	Students can name the basic concepts in Gra	ph Theory and Optimization. They are a	ble to explain the	em using appropria
	examples.			
	Students can discuss logical connections betw	ween these concepts. They are capable	of illustrating the	ese connections w
	the help of examples.			
	 They know proof strategies and can reproduce 	e them.		
Skills				
JKIIIS	 Students can model problems in Graph The 	ory and Optimization with the help of	the concepts stu	udied in this cours
	Moreover, they are capable of solving them by applying established methods.			
	 Students are able to discover and verify further 	er logical connections between the conce	pts studied in the	e course.
	 For a given problem, the students can deve 	lop and execute a suitable approach, a	nd are able to c	ritically evaluate f
	results.			
Personal Competence Social Competence	 Students are able to work together in teams. In doing so, they can communicate new conc design examples to check and deepen the unit 	epts according to the needs of their coop		
Autonomy	 Students are capable of checking their under precisely and know where to get help in solvir Students have developed sufficient persister problems. 	ng them.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Computer Scienc	e: Compulsory	
	Computer Science: Core Qualification: Compulsory			
J	General Engineering Science (English program, 7 ser	nester): Specialisation Computer Science	: Compulsory	
	Computational Science and Engineering: Core Qualif		, ,	
	Logistics and Mobility: Specialisation Engineering Sci			
	Technomathematics: Specialisation I. Mathematics: I			

Course L1046: Graph Theory	and Optimization
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	 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 Theory	Course L1047: Graph Theory and Optimization		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Anusch Taraz		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0727: Stoch	astics			
Courses				
Title Stochastics (L0777) Stochastics (L0778)		Typ Lecture Recitation Section (small)	Hrs/wk 2 2	CP 4 2
Module Responsible	Prof Marko Lindner	Necliation Section (smail)	2	2
Admission Requirements				
Recommended Previous Knowledge	Calculus Discrete algebraic structures (combinatorics) Propositional logic			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
	Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (randor variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and margine distributions, density functions). Students can describe characteristic notions such as expected values, variance, standar deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on th chain rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision an computation problem for stochastic processes. Students can also explain basic statistical detection and estimation techniques. Students can apply algorithms for solving decision problems, and they can justify whether approximation techniques are goo enough in various application contexts, i.e., students can derive estimators and judge whether they are applicable or reliable.			
	 Students can put their knowledge in relation to the con Students have developed sufficient persistence to be a 		al-oriented mann	er on hard problem
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Computer Science	e: Compulsory	
Following Curricula	Computer Science: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semes Computational Science and Engineering: Core Qualificati	ter): Specialisation Computer Science	: Compulsory	

Course L0777: Stochastics				
Тур	Lecture			
Hrs/wk	2			
CP	4			
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28			
Lecturer	Dr. Christian Seifert			
Language	DE/EN			
Cycle	SoSe			
Content	Foundations of probability theory			
	Definitions of probability, conditional probability			
	Random variables, dependencies, independence assumptions,			
	Marginal and joint probabilities			
	Distributions and density functions			
	Characteristics: expected values, variance, standard deviation, moments			
	Practical representations for joint probabilities			
	Bayessche Netzwerke			
	Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen			
	Stochastic processes			
	Stationarity, ergodicity			
	Correlations			
	Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues			
	Detection & estimation			
	Detectors			
	Estimation rules and procedures			
	Hypothesis and distribution tests			
	Stochastic regression			
Literature				
	Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008 Stochastik für Infermatiker, Dümbagen L., Springer 2003			
	 Stochastik für Informatiker, Dümbgen, L., Springer 2003 Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 			
	 Statistik: Der weg zur Datenanaryse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 Stochastik, Georgii, HO., deGruyter, 2009 			
	 Stochastik, Georgii, HO., deGruyter, 2009 Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001 			
	6. Programmieren mit R, Ligges, U., Springer 2008			

Course L0778: Stochastics			
Тур	ecitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	ndependent 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		

Courses					
Title		Тур	Hrs/wk	СР	
Automata Theory and Formal Lang	uages (L0332)	Lecture	2	4	
Automata Theory and Formal Lang	uages (L0507)	Recitation Section (small)	2	2	
Module Responsible	Prof. Tobias Knopp				
Admission Requirements					
	commended Previous Participating students should be able to				
Knowledge		ures (such as, e.g., arrays) to solve computational	problems		
	- apply propositional logic and predicate logic for specifying and understanding mathematical proofs				
	- apply the knowledge and skills taught in the module Discrete Algebraic Structures				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results			
Professional Competence					
	kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of f automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges deterministic and nondeterministic finite automata and pushdown automata to Turing machines. Students can name th formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which deci problems require which expressivity, and, in addition, students can transform decision problems w.r.t. one formalism into deci problems w.r.t. other formalisms. They understand that some formalisms easily induce algorithms whereas others are best su for specifying systems and their properties. Students can describe the relationships between formalisms such as logic, autom or grammars.				
Skills	Students can apply propositional logic as well as predicate logic resolution to a given set of formulas. Students analyze application problems in order to derive propositional logic, predicate logic, or temporal logic formulas to represent them. They can evalua which formalism is best suited for a particular application problem, and they can demonstrate the application of algorithms f decision problems to specific formulas. Students can also transform nondeterministic automata into deterministic ones, or deri- grammars from automata and vice versa. They can show how parsers work, and they can apply algorithms for the language emptiness problem in case of infinite words.				
Personal Competence					
Social Competence					
Autonomy	ļ				
	Independent Study Time 124, Study Time i	in Lecture 56			
Credit points					
Course achievement					
	Written exam				
Examination duration and					
Examination duration and scale					
Examination duration and scale Assignment for the	General Engineering Science (German proc	gram, 7 semester): Specialisation Computer Scien	ce: Elective Comp	ulsory	
Examination duration and scale	General Engineering Science (German proc Computer Science: Core Qualification: Corr	npulsory		-	
Examination duration and scale Assignment for the	General Engineering Science (German prog Computer Science: Core Qualification: Corr General Engineering Science (English prog	npulsory ram, 7 semester): Specialisation Computer Science		-	
Examination duration and scale Assignment for the	General Engineering Science (German proc Computer Science: Core Qualification: Corr	npulsory ram, 7 semester): Specialisation Computer Scienc ore Qualification: Compulsory		-	

Typ	Lecture		
Hrs/wk	Lecture		
01	4		
	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Tobias Knopp		
Language	EN		
Cycle	SoSe		
Content	1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF		
	2. Predicate logic, unification, predicate logic resolution		
	3. Temporal Logics (LTL, CTL)		
	4. Deterministic finite automata, definition and construction		
	 Deterministic inflice automata, definition and construction Regular languages, closure properties, word problem, string matching 		
	6. Nondeterministic automata:		
	Rabin-Scott transformation of nondeterministic into deterministic automata		
	7. Epsilon automata, minimization of automata,		
	elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states)		
	8. Myhill-Nerode Theorem:		
	Correctness of the minimization procedure, equivalence classes of strings induced by automata		
	9. 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 expres		
	enough to solve a word problem for some given language		
	10. Regular expressions vs. finite automata:		
	Equivalence of formalisms, systematic transformation of representations, reductions		
	11. Pushdown automata and context-free grammars:		
	Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pum		
	lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars		
	back)		
	12. Chomsky normal form		
	13. CYK algorithm for deciding the word problem for context-free grammrs		
	14. Deterministic pushdown automata		
	15. Deterministic vs. nondeterministic pushdown automata:		
	Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler		
	16. Regular grammars		
	17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars		
	18. Chomsky hierarchy		
	19. Mealy- and Moore automata:		
	Automata with output (w/o accepting states), infinite state sequences, automata networks		
	20. Omega automata: Automata for infinite input words, Büchi automata, representation of state transition systems, verifica		
	w.r.t. temporal logic specifications (in particular LTL)		
	21. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic		
	22. Fixed points, propositional mu-calculus		
	23. Characterization of regular languages by monadic second-order logic (MSO)		
Literature	1. Lasik für Informatikas Luce Cabining, Capitarum, E. Aufl		
	Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl. Logik für Informatiker Martin Krouzer, Stefan Kübling, Boarson Studium, 2006		
	 Logik f ür Informatiker Martin Kreuzer, Stefan K ühling, Pearson Studium, 2006 Grundluure Theoretike Lafermetike Catt		
	 Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007 		
	4. FILICIDIES OF MODEL CHECKING, CHIISTEI DAIEL, 100ST-FIELEL KALOEN, THE MIT PIESS, 2007		

Course L0507: Automata The	urse L0507: Automata Theory and Formal Languages		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	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: Embe	edded Systems				
Courses					
Title			Тур	Hrs/wk	СР
Embedded Systems (L0805) Embedded Systems (L0806)			Lecture Recitation Section (sr	3 nall) 1	4 2
Module Responsible	Prof. Heiko Falk				
Admission Requirements					
Recommended Previous		na			
Knowledge	comparer Engineering				
Educational Objectives		cessfully, students have	reached the following learning results		
Professional Competence	5.	cessiany, seadents nave			
-		can be defined as inform	ation processing systems embedded in	o enclosing products. Th	his course teaches t
	Embedded systems can be defined as information processing systems embedded into enclosing products. This course teaches the foundations of such systems. In particular, it deals with an introduction into these systems (notions, common characteristics) and their specification languages (models of computation, hierarchical automata, specification of distributed systems, task graph 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 a 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.				
Skills	After having attended the course, students shall be able to realize simple embedded systems. The students shall realize which relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall be able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge which areas of embedded system design specific risks exist.				
Personal Competence					
		solve similar problems a	lone or in a group and to present the re	sults accordingly.	
	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Course achievement		Form	Description		
course achievement	Yes 10 %	Subject theoretical	and		
		practical work			
Examination	Written exam				
Examination duration and	90 minutes, contents	s of course and labs			
scale					
Assignment for the	General Engineering	Science (German progra	m, 7 semester): Specialisation Compute	er Science: Elective Com	pulsory
Following Curricula	Computer Science: S	pecialisation Computer a	nd Software Engineering: Elective Com	pulsory	
	Electrical Engineering: Core Qualification: Elective Compulsory				
	Aircraft Systems Engineering: Specialisation Avionic and Embedded Systems: Elective Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory				
	Computational Science and Engineering: Core Qualification: Compulsory				
	Mechatronics: Specialisation System Design: Elective Compulsory				
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory				
	Microelectronics and	Microsystems: Specialisa	ation Embedded Systems: Elective Com	pulsory	
Course L0805: Embedded Sy	vstems				
Тур	Lecture				
Hrs/wk	3				
СР	4				
Workload in Hours	Indopondent Study T	ime 78 Study Time in Le	octure 12		

CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	rof. 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. 2 nd Edition, Springer, 2012., Springer, 2012. 	

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Internet S	-	Lecture	3	5
Computer Networks and Internet S	-	Recitation Section (small)	1	1
-	Prof. Andreas Timm-Giel			
Admission Requirements				
	Basics of Computer Science			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain important and common Internet protocols in detail and classify them, in order to be able to anal			
	and develop networked systems in further	r studies and job.		
Skills	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.			
01110			difference domainsr	
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of h	high amount of professional knowledge and can	independently learn	and understand it
Autonomy		ing i anoune of professional knowledge and can	independently learn	
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Computer Sc	ience: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Cor	npulsory		
	Data Science: Core Qualification: Elective	Compulsory		
	Electrical Engineering: Core Qualification:	Elective Compulsory		
	Engineering Science: Specialisation Mecha			
	General Engineering Science (English proc	gram, 7 semester): Specialisation Computer Sci	ence: Elective Compu	ulsory
	General Engineering Science (English proc	gram, 7 semester): Specialisation Mechatronics:	Elective Compulsory	1
	Computational Science and Engineering: C	Core Qualification: Compulsory		
	Technomathematics: Specialisation II. Info	armatics: Elective Compulsory		

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

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

Module M0731: Funct	ional Program	ming				
Courses						
Title			Тур		Hrs/wk	СР
Functional Programming (L0624)			Lectu	ıre	2	2
Functional Programming (L0625)			Recit	ation Section (large)	2	2
Functional Programming (L0626)			Recit	ation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp					
Admission Requirements	None					
Recommended Previous	Discrete mathematic	s at high-school lev	el			
Knowledge						
Educational Objectives	After taking part suc	cessfully, students ł	ave reached the following lea	arning results		
Professional Competence						
Kilowieage	to read Haskell prog errors in programs.	rams and to explair They apply the fun	and simple design technique Haskell syntax as well as Ha damental data structures, da echniques for partial and tota	skell's read-eval-print l ta types, and type cor	loop. They interpresent	et warnings and fir employ strategies fo
Skills	in a structured wa implementations lev	ay. They assess d el, and justify their	ription down in parts amenabl ifferent language constructs choice. They analyze given p ; the quality of their tests. The	s, make conscious se programs and rewrite t	elections both a hem in a controll	t specification an ed way. They desig
Personal Competence						
Social Competence	Students practice pe programs orally. The		ith varying peers. They explanglish.	ain problems and solut	tions to their pee	r. They defend the
Autonomy			nder supervision (a.k.a. "Bet ually and independently, and	-	") the mechanics	of programming.
Workload in Hours	Independent Study T	ime 96, Study Time	in Lecture 84			
Credit points	6					
Course achievement	Compulsory Bonus Yes 15 %	Form Excercises	Description			
Examination	Written exam					
Examination duration and	90 min					
scale						
Assignment for the	General Engineering	Science (German p	ogram, 7 semester): Specialis	sation Computer Science	e: Elective Comp	ulsorv
Following Curricula			-			
	Data Science: Core C	-				
		-	natronics: Elective Compulsor	v		
			ogram, 7 semester): Specialis	-	e: Elective Compu	llsorv
			ogram, 7 semester): Specialis			
			Specialisation I. Computer Sc			
					SOLA	
			Specialisation Computer Scie		-	

Course L0624: Functional Pro	pgramming
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	 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 Pr	ogramming
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.

Typ	Recitation Section (small)
Hrs/wk	
-	
-	2
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
	 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)

Module M0662: Nume	erical Mathematics I
Courses	
Title	Typ Hrs/wk CP
Numerical Mathematics I (L0417)	Lecture 2 3
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3
Module Responsible	Prof. Sabine Le Borne
Admission Requirements	None
Recommended Previous	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematici
Knowledge	 Matternauk F + in to Englineering Students (german of english) of Anarysis & Linear Algebra F + in to Fechnomathematic basic MATLAB knowledge
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to
	name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root find
	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.
	 explain aspects for the practical execution of numerical methods with respect to comparational and storage complexity.
Skille	Students are able to
JKIIIS	
	 implement, apply and compare numerical methods using MATLAB,
	 justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
	 select and execute a suitable solution approach for a given problem.
Personal Competence	
	Students are able to
Jocial competence	
	• work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms
Autonomy	Students are capable
Autonomy	Students are capable
	• to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
	 to assess their individual progess and, if necessary, to ask questions and seek help.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
Examination	
scale	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Computer Science. Computering, Focus Materials
ronowing curricula	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory
	Data Science: Core Qualification: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory Computational Science and Engineering: Core Qualification: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics 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 Ma	ourse L0418: Numerical Mathematics I		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne, Dr. Jens-Peter Zemke		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
ſitle		Тур	Hrs/wk	СР
ntroductory Seminar Computer Sc	ence I (L2362)	Seminar	2	3
ntroductory Seminar Computer Sc	ence II (L2361)	Seminar	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Basic knowledge of Computer Science and	Mathematics at the Bachelor's level.		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	The students are able to			
	explicate a specific topic in the field	d of Computer Science		
	 describe complex issues, 	d of computer science,		
	 present different views and evaluat 	e in a critical way		
Skills	The students are able to			
	 familiarize in a specific topic of Cor 	anuter Science in limited time		
	 realize a literature survey on the spectral structure structu			
	 elaborate a presentation and give a 			
	 sum up the presentation in 10-15 li 			
	 answer questions in the final discussion 	ssion.		
Personal Competence				
Social Competence	The students are able to			
	elaborate and introduce a topic for	a certain audience,		
	 discuss the topic, content and struct 	ture of the presentation with the instructor,		
	 discuss certain aspects with the au 	dience, and		
	 as the lecturer listen and respond t 	o questions from the audience.		
Autonomy	The students are able to			
	 define the task in question in an au 	tonomous way		
	 develop the necessary knowledge, 			
	 use appropriate work equipment, a 	nd		
	 guided by an instructor critically ch 			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement				
Examination	Presentation			
Examination duration and	X			
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Computer 9	Science: Elective Compu	lsory
-	Computer Science: Core Qualification: Co			
-		gram, 7 semester): Specialisation Computer S	cience: Elective Compul	sory
	Computational Science and Engineering:	Core Qualification: Compulsory		

Course L2362: Introductory	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: Introductory	Course L2361: Introductory Seminar Computer Science II		
Тур	Seminar		
Hrs/wk	2		
CP	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
Computer Architecture (L0793)			Lecture	2	3
Computer Architecture (L0794)			Project-/problem-based Learning	2	2
Computer Architecture (L1864)			Recitation Section (small)	1	1
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous	Module "Computer Engineering"				
Knowledge					
Educational Objectives	After taking part successfully, stude	nts have reached the follow	ving learning results		
Professional Competence					
	various programming models is g processors). Next, foundational asp so-called pipelining and the metho know concepts for dynamic sche hierarchies.	ects of the micro-architectu Is used for the acceleratio	n of instruction execution used in	e, the focus pa this context.	articularly lies on t The students get
Skills	The students are able to describe the organization of processors. They know the different architectural principles and programmir models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and t 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 p	oblems alone or in a group	and to present the results accord	ngly.	
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 Lecture 70			
Credit points	6				
Course achievement	Compulsory Bonus Form No 15 % Subject th practical wo				
Examination	Written exam				
Examination duration and scale	90 minutes, contents of course and	4 attestations from the PBL	- "Computer architecture"		
Assignment for the	General Engineering Science (Germ	an program, 7 semester): S	specialisation Computer Science: E	lective Compu	llsory
Following Curricula	Computer Science: Specialisation C				
2	Computer Science: Specialisation I.				
	Aircraft Systems Engineering: Speci	•			
	General Engineering Science (Englis	-		ective Compu	lsory
	Computational Science and Engine				
	Computational Science and Enginee	• · · ·			
	. 5 - 1				

Course L0793: Computer Arc	hitecture
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Heiko Falk
Language	DE/EN
Cycle	WiSe
Content	 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: Computer Architecture		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1864: Computer Architecture		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Τγρ	Hrs/wk	СР
Computability and Complexity The	ary (10166)	Lecture	2	3
Computability and Complexity The		Recitation Section (small)	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Discrete Algebraic Structures, Automata	Theory, Logic, and Formal Language Theory.		
Knowledge				
Educational Objectives	After taking part successfully, students h	have reached the following learning results		
Professional Competence				
Knowledge	The students known the important machine models of computability, the class of partial recursive functions, univer computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence syste Hilbert's 10-th problem, and the basic concepts of complexity theory.			
Skills	Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions.			
Personal Competence				
Social Competence	Students are able to solve specific proble	ems alone or in a group and to present the result	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	60 min			
scale				
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Computer Sci	ence: Elective Comp	ulsory
Following Curricula	Computer Science: Core Qualification: Co	ompulsory		
	Data Science: Core Qualification: Electiv	e Compulsory		
		ogram, 7 semester): Specialisation Computer Scie		ulsory
	Computational Science and Engineering	: Specialisation I. Computer Science: Elective Com	pulsory	
	Technomathematics: Specialisation II. In	formatics: Elective Compulsory		

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

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

Courses					
Title			Тур	Hrs/wk	СР
Software Engineering (L0627)			Lecture	2	3
Software Engineering (L0628)			Recitation Section (sm	all) 2	3
Module Responsible	Prof. Sibylle Schupp				
Admission Requirements	None				
Recommended Previous		and formal languages			
Knowledge	-	and formal languages			
		amming or Functional p programming, algorithm			
	 Object-oriented p 	orogramming, algorium	s, and data structures		
Educational Objectives	After taking part succes	sfully, students have re	ached the following learning results		
Professional Competence					
Knowledge	Students explain the	phases of the softwa	e life cycle, describe the fundamer	ital terminology and c	oncepts of softw
	engineering, and parap	hrase the principles of s	tructured software development. They	give examples of softwa	are-engineering ta
	of existing large-scale	systems. They write t	est cases for different test strategies	and devise specification	ons or models us
	different notations, and critique both. They explain simple design patterns and the major activities in requirements analy				quirements analy
	maintenance, and proje	ect planning.			
CI-111-					unista un stis al T
SKIIIS	ills For a given task in the software life cycle, students identify the corresponding phase and select an appropriate me choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the test				
	specifications.	eis. They apply and T	nodify non-executable artifacts. They	integrate components	based on intern
	specifications.				
Personal Competence					
Social Competence	Students practice peer	programming. They exp	lain problems and solutions to their pe	er. They communicate in	n English.
Autonomy	Ultime on line quizzes and accompanying material for solf study, students can access their level of knowledge continuously s				
Autonomy	V Using on-line quizzes and accompanying material for self study, students can assess their level of knowledge continuously ar adjust it appropriately. Working on exercise problems, they receive additional feedback.				
	aujust it appropriately. Working on exercise problems, they receive auditional regulation.				
Workload in Hours	Independent Study Tim	e 124, Study Time in Le	cture 56		
Credit points	6				
Course achievement		Form	Description		
		Excercises			
Examination	Written exam				
Examination duration and	90 min				
scale					
			, 7 semester): Specialisation Computer	Science: Elective Comp	oulsory
Following Curricula	Computer Science: Core		•		
			7 semester): Specialisation Computer		ulsory
	Computational Science	and Engineering, English	alisation I. Computer Science: Elective (Compulsory	

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

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

Module M0971: Opera	ting 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 Procedural programming Experience in using tools related to operating Experience in using C-libraries 		rs	
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Skills	process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using thread conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms. 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	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Computer Science	e: Elective Compu	ulsory
Following Curricula	Computer Science: Core Qualification: Compulsory			
	Computer Science: Specialisation I. Computer and Sc	oftware Engineering: Elective Compulsory		
	General Engineering Science (English program, 7 sen	nester): Specialisation Computer Science	Elective Compu	lsory
	Computational Science and Engineering: Specialisation	on I. Computer Science: Elective Compuls	ory	
	Technomathematics: Specialisation II. Informatics: El	ective Compulsory		

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

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

Courses				
Title	Typ Hrs/wk CP			
Lab Cyber-Physical Systems (L1740				
Module Responsible				
Admission Requirements				
	Module "Embedded Systems"			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence	· · · · · · · · · · · · · · · · · · ·			
Knowledge	Cyber-Physical Systems (CPS) are tightly integrated with their surrounding environment, via sensors, A/D and D/A converters, actors. Due to their particular application areas, highly specialized sensors, processors and actors are common. Accordingly, t is a large variety of different specification approaches for CPS - in contrast to classical software engineering approaches. Based on practical experiments using robot kits and computers, the basics of specification and modelling of CPS are taught. Iab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of compute hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors actors.			
Skills	After successful attendance of the lab, students are able to develop simple CPS. They understand the interdependencies betwee CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D convert digital processors, D/A converters and actors. The lab enables students to compare modelling approaches, to evaluate t advantages and limitations, and to decide which technique to use for a concrete task. They will be able to apply these technic to practical problems. They obtain first experiences in hardware-related software development, in industry-relevant specifica			
	tools and in the area of simple control applications.			
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a group and to present the results accordingly.			
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory			
Following Curricula	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			
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory			
	Mechatronics: Specialisation System Design: Elective Compulsory			
	Mechatronics: Technical Complementary Course: Elective Compulsory			
Course L1740: Lab Cyber-Ph	voical Systems			
Typ	Project-/problem-based Learning			
Hrs/wk				
CP				
Workload in Hours				

Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	rrof. 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-Physical Systems. 2 nd Edition, Springer, 2012. Begleitende Foliensätze 	

Admission Requirements Recommended Previous Knowledge	Prof. Natalie Neumeyer None Mathematical Stochastics Measure Theory and Stochastics	Typ Lecture Recitation Section (small)	Hrs/wk 3 1	CP 4 2
Mathematical Statistics (L1339) Mathematical Statistics (L1340) Module Responsible Admission Requirements Recommended Previous Knowledge	None Mathematical Stochastics	Lecture	3	4
Mathematical Statistics (L1340) Module Responsible Admission Requirements Recommended Previous Knowledge	None Mathematical Stochastics			
Admission Requirements Recommended Previous Knowledge	None Mathematical Stochastics			
Recommended Previous Knowledge	Mathematical Stochastics			
Knowledge				
-	Measure Theory and Stochastics			
	neusure meery and stochastics			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence	and carries part successions, statemes na			
Knowledge				
	sufficiency and completeness and confidence domains and test familie	d their application to estimation and test prot es. They are able to explain them using appropria ctions between these concepts. They are capat	olems, tests in nor ate examples.	mal distribution a
Skills	are capable of solving them by applStudents are able to discover and v	thematical Statistics with the help of the concep lying established methods. erify further logical connections between the con can develop and execute a suitable approach	ncepts studied in the	e course.
Personal Competence Social Competence	In doing so, they can communicate	in teams. They are capable to use mathematics a new concepts according to the needs of their co pen the understanding of their peers.		
Autonomy	 Y Students are capable of checking their understanding of complex concepts on their own. They can specify open qu precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner o problems. 			
	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
	None Written oxem			
	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory			

Course L1339: Mathematical	Statistics	
Тур	Lecture	
Hrs/wk	3	
CP	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. 	

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

Specialization Mechanical Engineering

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

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

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

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

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

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

Module M0598: Mechanical Engineering: Design

Courses					
Title			Тур	Hrs/wk	СР
Embodiment Design and 3D-CAD (I			Lecture	2	1
Mechanical Design Project I (L0695)			Project-/problem-based Le	arning 3	2
Mechanical Design Project II (L0592)			Project-/problem-based Le	-	2
Team Project Design Methodology	1		Project-/problem-based Le	arning 2	1
Module Responsible	Prof. Dieter Krau	se			
Admission Requirements	None				
Recommended Previous	Fundamer	ntals of Mechanical Engineeri	na Desian		
Knowledge	• Fundamentals of Mechanical Engineering Design • Mechanics				
		ntals of Materials Science			
		n Engineering			
		5 5			
Educational Objectives	After taking part	successfully, students have	reached the following learning results		
Professional Competence					
Knowledge	After passing the	e module, students are able to	0:		
	• explain de	sign quidelines for machiner	y parts e.g. considering load situation, mater	rials and manufactu	rina requirement
		pasics of 3D CAD,	, parts eigi considering load situation, mate		ing requirement
		sics methods of engineering	designing.		
Skills	After passing the	e module, students are able to	0:		
	 independe 	ently create sketches, technic	al drawings and documentations e.g. using	3D CAD.	
	 independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, 				
	 dissign components based on design galacimes addenomously, dimension (calculate) used components, 				
	 use methods to design and solve engineering design tasks systamtically and solution-oriented, 				
		ativity techniques in teams.			
Personal Competence					
Social Competence	After passing the	e module, students are able t	0:		
	 develop and evaluate solutions in groups including making and documenting decisions, 				
	 moderate 	the use of scientific methods	, ,		
	 present ar 	nd discuss solutions and tech	nical drawings within groups,		
	 reflect the 	e own results in the work grou	ips of the course.		
Autonomy	Students are abl	e			
		to the similar of the soule data of			
		ngineering design tasks system	sing activating methods within the lectures	(e.g. with clickers),	
	• 10 301/2 6	ingineering design tasks syst			
Workload in Hours	Independent Stu	dy Time 40, Study Time in Le	ecture 140		
Credit points	6				
Course achievement			Description		
	Yes None		Teamprojekt Konstruktionsmethodik		
	Yes None		Konstruktionsprojekt 1		
	Yes None		Konstruktionsprojekt 2		
	Yes None	Written elaboration	3D-CAD-Praktikum		
Examination	Written exam				
Examination duration and	180				
scale					
-	-		m, 7 semester): Specialisation Mechanical Er		-
Following Curricula	_		m, 7 semester): Specialisation Biomedical Er		
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory				
	55	5 5			
	-		n, 7 semester): Specialisation Mechanical En		-
	-		n, 7 semester): Specialisation Biomedical En n, 7 semester): Specialisation Energy and En		-
	i General Engiñee	nnu science rendiish pròdran	u v semesteri: specialisation Energy and En	viromental Enginee	uuu: uumpuisor\

Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

Course L0268: Embodiment I	Design and 3D-CAD
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	 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. Maschinenelemente, Band I-III; Niemann, G., 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: Mechanical Design Project I		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
CP	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	WiSe	
Content	 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: Mechanical Design Project II		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
CP	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. 	

rse L0267: Team Project	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

	amentals of Materials Science			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials Science	I (L1085)	Lecture	2	2
	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Ma	terials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. The for materials and can identify relevant approaches for char phenomena back to the underlying physical and chemical laws	cally the issues of ato he students know abo aracterizing specific	omic structure, microstructu out the key aspects of char	ure, phase diagra acterization met
Skills	The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stre resistance, and to phase transformations such as solidification between processing conditions and the materials microstructor material's behavior.	ngth, ductility, and s	tiffness, chemical propertie melting. The students can	es such as corro explain the rela
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Mechan	nical Engineering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Biomed	lical Engineering: Compulso	ory
	General Engineering Science (German program, 7 semester): S	pecialisation Naval A	architecture: Compulsory	
	General Engineering Science (German program, 7 semester): S		and Enviromental Engineer	ring: Compulsory
	Energy and Environmental Engineering: Core Qualification: Con			
	General Engineering Science (English program, 7 semester): Sp		5 5 1	5
	General Engineering Science (English program, 7 semester): Sp			У
	General Engineering Science (English program, 7 semester): Sp			
	General Engineering Science (English program, 7 semester): Sp		and Enviromental Engineeri	ng: Compulsory
	Logistics and Mobility: Specialisation Engineering Science: Elect	tive Compulsory		
	Mechanical Engineering: Core Qualification: Compulsory			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Ele	activo Computant		

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

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

Course L1095: Physical and O	Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Fritz 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", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer

Module M0680: Fluid	Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics, engineer	ring mechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to Students can scientifically outline the rationale of flow performance analysis and the prediciton of fluid engine	physics using mathematical models a		
Skills	Students are able to apply fluid-engineering principles enables the student to carry out all necessary theored scientific level.			-
Personal Competence				
Social Competence	The students are able to discuss problems and jointly d	evelop solution strategies.		
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			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engin	eering: Compulso	iry
Following Curricula	General Engineering Science (German program, 7 seme	ester): Specialisation Biomedical Engin	eering: Compulso	ry
	General Engineering Science (German program, 7 seme	ester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical Engine	ering: Compulso	У
	General Engineering Science (English program, 7 seme	ster): Specialisation Biomedical Engine	ering: Compulsor	У
	General Engineering Science (English program, 7 seme	ster): Specialisation Naval Architecture	: Compulsory	
	Computational Science and Engineering: Specialisation			
	Mechanical Engineering: Core Qualification: Compulsory	/		
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Scie			

Course L0454: Fluid Mechani	ics
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	 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 Mechan	ics
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
Mechanics IV (Kinetics II, Oscillatio				Lecture	3	3
Mechanics IV (Kinetics II, Oscillatio	-			Recitation Section (small)	2	2
Mechanics IV (Kinetics II, Oscillatio		s, Multibody Systems) (L11	.39)	Recitation Section (large)	1	1
Module Responsible						
Admission Requirements						
Recommended Previous Knowledge	Mathematics I-III and	Mechanics I-III				
Educational Objectives	After taking part suc	cossfully, students have	reached the followi	na loarning results		
Professional Competence		cessiuily, students nave	reached the following	ing learning results		
-	The students can					
Khowieuge	The students curr					
		axiomatic procedure used		texts;		
		tant steps in model desig	gn;			
	 present techn 	ical knowledge.				
Skills	The students can					
	 explain the in 	portant elements of ma	athematical / mecha	nical analysis and model for	mation and annl	v it to the context
	their own prof		inematical / meena	filear analysis and model for		y it to the context
		ethods to engineering pr	roblems;			
				tend them to be applicable t	o wider problem	sets.
		ork in groups and support		come difficulties. aknesses and to organize the	eir time and learn	ing based on those
Workload in Hours	Independent Study T	Time 96, Study Time in L	ecture 84			
Credit points						
Course achievement	Compulsory Bonus	Form	Description			
	No 20 %	Midterm	Wird nur im S	SoSe angeboten		
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the				ecialisation Mechanical Engin		
Following Curricula				ecialisation Biomedical Engin		ory
		chnical Complementary (ecialisation Naval Architectur	e. compuisory	
				cialisation Mechanical Engine	eerina: Compulso	rv
				cialisation Biomedical Engine		
				cialisation Naval Architecture		-
	Mechanical Engineer	ring: Core Qualification: (Compulsory		-	
	Mechatronics: Core (Qualification: Compulsor	У			
	Naval Architecture: 0	Core Qualification: Comp	oulsory			
	Technomathematics	: Specialisation III. Engin	eering Science: Elec	tive Compulsory Course Core Studies: Elective		

Course L1137: Mechanics IV	(Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	 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
CP	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 in

Literature

See interlocking course

See interlocking course

Courses						
Title				Тур	Hrs/wk	СР
Practical Course: Measurement and	Control Systems (L1119)			Practical Course	2	2
Measurement Technology for Mech	anical Engineering (L1116))		Lecture	2	3
Measurement Technology for Mech	anical Engineering (L1118))		Recitation Section (large)	1	1
Module Responsible	Prof. Thorsten Kern					
Admission Requirements	None					
Recommended Previous	Basic knowledge of phy	sics, chemistry and e	lectrical engineering]		
Knowledge						
Educational Objectives	After taking part succes	sfully, students have	reached the followi	ng learning results		
Professional Competence						
Knowledge	Students are able to na	ame the most import	ant fundmentals of	the Measurement Techno	logy (Quantities and	d Units, Uncertai
	Calibration, Static and					
				lifferent kinds of quantitie	es to be maesured (Electrical Quanti
	Temperature, mechanic	ai quantities, Flow, I	ime, Frequency).			
	They can describe impo	ortant methods of che	mical Analysis (Gas	Sensors, Spectroscopy, G	as Chromatography)	
Skills	Students can select suit	table measuring meth	ods to given proble	ms and can use refering n	neasurement device	s in practice.
				<i>c</i>		
				a of measurement techno	logy and solution ap	pproaches as we
	place the issues into the	e right context and ap	plication area.			
Personal Competence						
Casial Competence						
Social Competence	Students can arrive at w	vork results in groups	and document the	n in a common report.		
Social Competence	Students can arrive at w	vork results in groups	and document the	n in a common report.		
Social Competence	Students can arrive at v	vork results in groups	and document the	n in a common report.		
	Students can arrive at v Students are able to far					
Autonomy	Students are able to far	niliarize themselves v	vith new measurem			
Autonomy Workload in Hours	Students are able to far Independent Study Tim	niliarize themselves v	vith new measurem			
Autonomy Workload in Hours Credit points	Students are able to far Independent Study Tim 6	miliarize themselves v e 110, Study Time in	vith new measurem Lecture 70			
Autonomy Workload in Hours	Students are able to far Independent Study Tim 6 Compulsory Bonus	niliarize themselves v e 110, Study Time in Form	vith new measurem Lecture 70 Description			
Autonomy Workload in Hours Credit points	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None S	niliarize themselves v e 110, Study Time in Form Subject theoretical	vith new measurem Lecture 70 Description			
Autonomy Workload in Hours Credit points Course achievement	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None S	niliarize themselves v e 110, Study Time in Form	vith new measurem Lecture 70 Description			
Autonomy Workload in Hours Credit points Course achievement Examination	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None I Written exam	niliarize themselves v e 110, Study Time in Form Subject theoretical	vith new measurem Lecture 70 Description			
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None I Written exam	niliarize themselves v e 110, Study Time in Form Subject theoretical	vith new measurem Lecture 70 Description			
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None S Written exam 105 minutes	niliarize themselves v e 110, Study Time in Form Subject theoretical practical work	vith new measurem Lecture 70 Description and	ent technologies.		
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None I Written exam 105 minutes General Engineering Sc	niliarize themselves v e 110, Study Time in Form Subject theoretical practical work ience (German progra	vith new measurem Lecture 70 Description and m, 7 semester): Sp	ent technologies.		
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	Students are able to far Independent Study Tim 6 Compulsory Bonus I Yes None I Written exam 105 minutes General Engineering Sc General Engineering Sc	niliarize themselves v e 110, Study Time in Form Subject theoretical practical work ience (German progra ience (German progra	vith new measurem Lecture 70 Description and and m, 7 semester): Sp im, 7 semester): Sp	ent technologies. ecialisation Mechanical En ecialisation Biomedical En	gineering: Compulso	bry
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Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to far Independent Study Tim 6 Compulsory Bonus T Yes None S Written exam 105 minutes General Engineering Sc General Engineering Sc General Engineering Sc Digital Mechanical Engi Energy and Environmer Engineering Science: Sp Engineering Science: Sp Engineering Science: Sp Engineering Science: Sp General Engineering Sc General Engineering Sc	miliarize themselves v e 110, Study Time in Form Subject theoretical practical work ience (German progra ience (English progra	vith new measurem Lecture 70 Description and and am, 7 semester): Sp am, 7 semester): Sp am, 7 semester): Sp ation: Compulsory Qualification: Com pulsory cal Engineering: Ele- m, 7 semester): Spe m, 7 semester): Spe	ent technologies. ecialisation Mechanical En ecialisation Biomedical En ecialisation Energy and Er pulsory tive Compulsory trive Compulsory trialisation Energy and En- trialisation Mechanical Eng trialisation Mechatronics:	gineering: Compulso viromental Engineeri gineering: Compulso jineering: Compulso Compulsory gineering: Compulso	pry ring: Compulsory ing: Compulsory ry ry ry

	Practical Course
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Thorsten Kern
Language	
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseo pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine v be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications w 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 am Arbeitsplatz. 2. Au Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbu Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltur Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 BI.1, 2451 BI.4, 2453 BI.5, 2455 BI.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 Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

Course L1116: Measurement	: Technology for Mechanical Engineering
Тур	Lecture
Hrs/wk	
СР	3
	Prof. Thorsten Kern, Dennis Kähler
Language	
Cycle	Vise 1 Fundamentals
Content	1.1 Quantities and Units
	1.2 Uncertainty
	1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	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
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3.
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.

Course L1118: Measurement	ourse L1118: Measurement Technology for Mechanical Engineering	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	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	

Module M0865: Funda	amentals of Production an	d Quality Management		
Courses				
Title Production Process Organization (LI Quality Management (L0926))925)	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, student	ts have reached the following learning results		
5	Students are able to explain the contents of the students are able to apply the metho	ents of the lecture of the module. ds and models in the module to industrial probler	ns.	
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 Minuten			
scale				
Assignment for the	General Engineering Science (German	n program, 7 semester): Specialisation Mechanica	I Engineering: Elective	Compulsory
Following Curricula	General Engineering Science (Germ	an program, 7 semester): Specialisation Mecha	anical Engineering, Foo	cus Aircraft Systems
	Engineering: Compulsory			
		n program, 7 semester): Specialisation Mechanic	al Engineering, Focus F	Product Development
	and Production: Compulsory			
	Engineering Science: Core Qualificatio			
		program, 7 semester): Specialisation Mechanical		Compulsory
		program, 7 semester): Core Qualification: Compu	llsory	
	5 , 1	Engineering Science: Elective Compulsory		
	Mechanical Engineering: Core Qualific	ation: Elective Compulsory		

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

Course L0926: Quality Manag	ourse L0926: Quality Management		
Тур	Lecture		
Hrs/wk	2		
CP	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, 6. Aufl. 2009 		

Courses				
Title		Тур	Hrs/wk	СР
Electrical Machines and Actuators	L0293)	Lecture	3	4
Electrical Machines and Actuators		Recitation Section (large)	2	2
Module Responsible	Prof. Thorsten Kern			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular complexe r	numbers, integrals, differentials		
Knowledge				
	Basics of electrical engineering and mechanical	engineering		
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic pri	nciples of electric and magnetic fields.		
	They can describe the function of the stan	dard types of electric machines and proce	ant the correspond	ding equations
	They can describe the function of the stand characteristic curves. For typically used drives			
	from the power grid to the driven engine.	they can explain the major parameters of the	energy eniciency	of the whole syst
Skills	Students arw able to calculate two-dimensiona		erromagnetic circu	its with air gap.
	this they apply the usual methods of the design	auf electric machines.		
	They can calulate the operational performance	e of electric machines from their given chara	acteristic data and	selected quantit
	and characteristic curves. They apply the usual	equivalent circuits and graphical methods.		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate o			
	Students are able independently to calculate e	lectric and magnatic fields for applications. T	hey are able to an	alyse independe
	the operational performance of electric machine			
	the operational performance of electric machin			
	the operational performance of electric machi and characteristic curves.	nes from the charactersitic data and theycar		
Workload in Hours	the operational performance of electric machinand characteristic curves. Independent Study Time 110, Study Time in Le	nes from the charactersitic data and theycar		
Credit points	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6	nes from the charactersitic data and theycar		
Credit points Course achievement	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None	nes from the charactersitic data and theycar		
Credit points Course achievement Examination	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work	nes from the charactersitic data and theycar		
Credit points Course achievement Examination Examination duration and	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None	nes from the charactersitic data and theycar		
Credit points Course achievement Examination Examination duration and scale	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review	nes from the charactersitic data and theycar cture 70 of design files	n calculate thereof	selected quanti
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi	n calculate thereof	selected quanti
Credit points Course achievement Examination Examination duration and scale	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine	romental Engineer ering: Elective Cor	i selected quantii
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engine	romental Engineer ering: Elective Cor neering: Elective C	ing: Compulsory npulsory compulsory
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Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical	romental Engineer ering: Elective Cor neering: Elective Co Engineering, Focu	ing: Compulsory npulsory compulsory senergy System
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical	romental Engineer ering: Elective Cor neering: Elective C Engineering, Focu al Engineering, F	ing: Compulsory npulsory compulsory us Energy System cocus Mechatron
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical	romental Engineer ering: Elective Cor neering: Elective C Engineering, Focu al Engineering, F	ing: Compulsory npulsory compulsory us Energy System cocus Mechatron
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Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Elect Energy and Environmental Engineering: Core Q General Engineering Science (English program,	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engi on: Compulsory ve Compulsory ualification: Compulsory 7 semester): Specialisation Electrical Enginee	romental Engineer ering: Elective Cor neering: Elective C Engineering, Focu al Engineering, Focu al Engineering, Focus Th neering, Focus Th	ing: Compulsory npulsory compulsory senergy System focus Mechatron eoretical Mechan
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Elect Energy and Environmental Engineering: Core Q General Engineering Science (English program, General Engineering Science (English program,	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engi on: Compulsory ve Compulsory ualification: Compulsory 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee	romental Engineer ering: Elective Cor neering: Elective C Engineering, Focu al Engineering, Focu al Engineering, Focus Th neering, Focus Th	ing: Compulsory mpulsory compulsory senergy System focus Mechatron eoretical Mechan mpulsory ng: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Elect Energy and Environmental Engineering: Core Q General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program,	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi am, 7 semester): Specialisation Mechanical Engi on: Compulsory ve Compulsory ualification: Compulsory 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee	romental Engineer ering: Elective Cor neering: Elective Cor al Engineering, Focu al Engineering, Focus Th neering, Focus Th ering: Elective Corr omental Engineeri eering: Elective Corr	ing: Compulsory mpulsory compulsory senergy System focus Mechatron eoretical Mechan mpulsory ng: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Elect Energy and Environmental Engineering: Core Q General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Computational Science and Engineering: Specia	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envir , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi am, 7 semester): Specialisation Mechanical Engi on: Compulsory ve Compulsory ualification: Compulsory 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Electrical Enginee 7 semester): Specialisation Mechanical Enginee 7 semester): Specialisation Mechanical Enginee 7 semester): Specialisation Mechanical Enginee 7 semester): Specialisation Mechanical Enginee 1 semester): Specialisation Mechanical Engi	romental Engineer ering: Elective Cor neering: Elective Cor al Engineering, Focu al Engineering, Focus Th neering, Focus Th ering: Elective Corr omental Engineeri eering: Elective Corr	ing: Compulsory mpulsory compulsory senergy System focus Mechatron eoretical Mechan mpulsory ng: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Elect Energy and Environmental Engineering: Core Q General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Computational Science and Engineering: Special Logistics and Mobility: Specialisation Engineering	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi ram, 7 semester): Specialisation Mechanical Engi on: Compulsory ve Compulsory ve Compulsory valification: Compulsory 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 9 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 1 semester): Sp	romental Engineer ering: Elective Cor neering: Elective Cor al Engineering, Focu al Engineering, Focus Th neering, Focus Th ering: Elective Corr omental Engineeri eering: Elective Corr	ing: Compulsory mpulsory compulsory senergy System focus Mechatron eoretical Mechan mpulsory ng: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	the operational performance of electric machin and characteristic curves. Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Elect Energy and Environmental Engineering: Core Q General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Computational Science and Engineering: Specia	nes from the charactersitic data and theycar cture 70 of design files , 7 semester): Specialisation Energy and Envi , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi ram, 7 semester): Specialisation Mechanical Engi on: Compulsory ve Compulsory ve Compulsory valification: Compulsory 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 9 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Electrical Engine 1 semester): Sp	romental Engineer ering: Elective Cor neering: Elective Cor al Engineering, Focu al Engineering, Focus Th neering, Focus Th ering: Elective Corr omental Engineeri eering: Elective Corr	ing: Compulsory mpulsory iompulsory is Energy Syste focus Mechatron eoretical Mechan mpulsory ng: Compulsory

Course L0293: Electrical Mac	hines 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
Content	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
	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
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313
	Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122
	"Grundlagen der Elektrotechnik" - anderer Autoren
	Fachbücher "Elektrische Maschinen"

Course L0294: Electrical Machines 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 M0934: Adva	nced Materials			
Courses				
itle		Тур	Hrs/wk	СР
Advanced Materials Characterizatio	on (L1087)	Lecture	2	2
Advanced Materials Design (L1091)	Lecture	2	2
Advanced Materials Design (L1092)	Recitation Section (large	e) 2	2
Module Responsible	Prof. Patrick Huber			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science (I and	II)		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students will be able to explain the p	properties of advanced materials along with the	heir applications in teo	hnology, in particu
	metallic, ceramic, polymeric, semiconduc	tor, modern composite materials (biomaterials	s) and nanomaterials.	
Skills		erial configurations according to the technic		
	materials considering architectural princ	ciples from the micro- to the macroscale. The	he students will also	gain an overview
	modern materials science, which enables	them to select optimum materials combination	ons depending on the t	echnical applicatio
Personal Competence				
	The students are able to present solution	s to specialists and to develop ideas further.		
Social competence	The stadents are use to present solution.			
Autonomy	The students are able to			
Autonomy	The students are able to			
	 assess their own strengths and we 	aknesses.		
	 define tasks independently. 			
Workload in Hours	Independent Study Time 96, Study Time i	in Lecture 84		
Credit points	6			
Course achievement				
	Written exam			
Examination duration and				
scale	50 mm			
	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mechanical	Engineering: Elective	Compulsory
Following Curricula		program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mech		
ronowing curricula	Compulsory	program, / semester). Specialisation Met	namear Engineering,	Tocus Diomechall
		program, 7 semester): Specialisation Me	chanical Engineering	Focus Materials
	Engineering Sciences: Compulsory	program, / semester). Specialisation Me	chanical Lingineering,	rocus matellais
		ionco: Compulsory		
	Data Science: Specialisation Materials Sci		Engineering, Elective (Sompulcon
	General Engineering Science (English pro Mechanical Engineering: Core Qualificatio	gram, 7 semester): Specialisation Mechanical	Engineering: Elective (Lompulsory

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

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

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

Focus Biomechanics

Module M0507, Adver	iomechanics get in addition to their core engineering sl ables them to understand operational planning as well a	as research and development in	this highly litter	disciplinary area.	
Auva	nced Mechanical Engineering Design				
Courses					
Title		Тур	Hrs/wk	СР	
dvanced Mechanical Engineering		Lecture	2	2	
Advanced Mechanical Engineering Advanced Mechanical Engineering		Recitation Section (large) Lecture	2 2	1 2	
Advanced Mechanical Engineering		Recitation Section (large)	2	1	
Module Responsible	-				
Admission Requirements					
Recommended Previous					
Knowledge	 Fundamentals of Mechanical Engineering Design Mechanics 				
	Fundamentals of Materials Science				
	Production Engineering				
Educational Objectives					
Professional Competence	After taking part successfully, students have reached the for	bliowing learning results			
-	After passing the module, students are able to:				
omedge					
	explain complex working principles and functions of				
	 explain requirements, selection criteria, application indicate the background of dimensioning calculation 		i complex machin	ne elements,	
	· maleate the background of annensioning calculation	5.			
Skills	After passing the module, students are able to:				
	accomplish dimensioning calculations of covered ma	achine elements,			
	transfer knowledge learned in the module to new reg	quirements and tasks (problem solv	/ing 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 locture supported by activation	a mothods		
		The recture supported by activating	g methous.		
Autonomy	 Students are able to independently deepen their acc 	uired knowledge in exercises.			
	 Students are able to acquire additional knowledge 		tood content e.g	. by using the vide	
	recordings of the lectures.				
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and	120				
scale					
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Mechanical I	Engineering, Foc	us Aircraft System	
-	Engineering: Compulsory			-	
-	Engineering: Compulsory General Engineering Science (German program, 7 se			-	
-	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory	mester): Specialisation Mechanic	al Engineering,	Focus Materials	
-	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser	mester): Specialisation Mechanic	al Engineering,	Focus Materials	
-	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory	mester): Specialisation Mechanic	al Engineering, I Engineering, F	Focus Materials	
-	Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Compulsory	mester): Specialisation Mechanic	al Engineering, I Engineering, F	Focus Materials	
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

	hanical Engineering Design II			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff			
Language	DE			
Cycle	SoSe			
Content	Advanced Mechanical Engineering Design I & II			
	Lecture			
	Fundamentals of the following machine elements:			
	 Linear rolling bearings 			
	• Axes & shafts			
	• Seals			
	Clutches & brakes			
	• Belt & chain drives			
	Gear drives			
	 Epicyclic gears 			
	Crank drives			
	 Sliding bearings 			
	Elements of fluidics			
	Calculation methods of the following machine elements:			
	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. Sieffihrung in die DIN Narman: Klain M. Tauhan Verlag			
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl. G.: Beitz, W., 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, aktuel 			
	Auflage.			
	 Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. 			

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

Course L0262: Advanced Me	chanical Engineering Design I
	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
Content	
	Lecture
	Fundamentals of the following machine elements:
	 Linear rolling bearings
	• Axes & shafts
	• Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	• Belt & chain drives
	Gear drives
	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.
	Sowie weitere Bücher zu speziellen Themen

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

Module M1277: MED	I: Introduction to Anatomy				
Courses					
Title		Тур	Hrs/wk	СР	
Introduction to Anatomy (L0384)		Lecture	2	3	
Module Responsible	Prof. Udo Schumacher				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	The students can describe basal structures a	and functions of internal organs and the m	usculoskeletal system.		
	The students can describe the basic macros	copy and microscopy of those systems.			
Skills	The students can recognize the relationship	between given anatomical facts and the d	evelopment of some cor	nmon diseases: th	
JKIIIS	can explain the relevance of structures and	-		innon discuses, di	
	can explain the relevance of structures and		a discuses.		
Personal Competence					
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.				
Διιτοποπγ	Autonomy The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and a the relevant knowledge themselves.				
hatohonny					
Workload in Hours	Independent Study Time 62, Study Time in L	ecture 28			
Credit points	3				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 minutes				
scale					
Assignment for the	General Engineering Science (German progr	am, 7 semester): Specialisation Biomedica	l Engineering: Compulso	ry	
Following Curricula	General Engineering Science (German pr	ogram, 7 semester): Specialisation Med	chanical Engineering, F	ocus Biomechani	
	Compulsory				
	Electrical Engineering: Specialisation Medica				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics				
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	Mechanical Engineering: Specialisation Biom				
	Biomedical Engineering: Specialisation Medi				
	Biomedical Engineering: Specialisation Mana				
	Biomedical Engineering: Specialisation Artifi				
	Biomedical Engineering: Specialisation Impla		sory		
	Technomathematics: Specialisation III. Engin	eering Science: Elective Compulsory			

urse L0384: Introduction t	to Anatomy		
Тур			
Hrs/wk			
СР			
	dependent Study Time 62, Study Time in Lecture 28		
	r Prof. Tobias Lange		
Language			
	SoSe		
content	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		
	7 th week: Genito-urinary System 8 th week: Immune system		
	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		
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016		

Courses				
Courses				
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4
Signals and Systems (L0432)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge				
-	The modul is an introduction to the theory of signals a		-	
	1-3 is expected. Further experience with spectral tran	isformations (Fourier series, Fourier tr	ansform, Laplace	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals	and linear time-invariant (LTI) systems	s using methods (of signal and syste
	theory. They are able to apply the fundamental trans	formations of continuous-time and dis	crete-time signals	s and systems. Th
	can describe and analyse deterministic signals and s	ystems mathematically in both time a	ind image domai	n. In particular, th
	understand the effects in time domain and image do	main which are caused by the trans	tion of a continu	ous-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determ	inistic signals and linear time-invariant	systems using m	nethods of signal a
	system theory. They can analyse and design basic			
	response, stability, linearity etc They can assess the	mpact of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence				
	The students can jointly solve specific problems.		_	
Autonomy	The students are able to acquire relevant information			ontrol their level
	knowledge during the lecture period by solving tutoria		em.	
	Independent Study Time 110, Study Time in Lecture 7)		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	90 min			
scale				
	General Engineering Science (German program, 7 sem			1
Following Curricula	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	i Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program, 7 s	emester): Specialisation Mechanical	Engineering Foc	us Energy System
	Compulsory	semester). Specialisation mechanical	Lingineering, Toe	us Energy System
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Aircraft System
	Engineering: Compulsory		,,,,,,,,,,,,,,,,,,,,,,	
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory		5 5.	
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	al Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Bioprocess Engine	ering: Compulsor	гу
	General Engineering Science (English program, 7 seme	ester): Specialisation Biomedical Engine	ering: Compulso	ry
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syster
	Engineering: Compulsory	anton). Consciolization March 1975	and the state	teriele in En 1
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engin	eering, Focus Mat	leriais in Engineeri
	Sciences: Compulsory	comostor), Crossielization March	Engineering	Focus Masteria '
	General Engineering Science (English program, 7 Compulsory	semester): specialisation Mechanica	ii Engineering, I	-ocus Mechatroni
	Compulsory	ester). Specialisation Mochanical Fast	peering Ecour Th	enetical Machani
	General Engineering Science (English program, 7 sem Engineering: Compulsory	ester, specialisation mechanical Engli	icening, rocus In	
	Computational Science and Engineering: Core Qualifica	ation: Compulsory		
	comparational science and Engineering. Core Qualifica	compaisory		
	Mechatronics: Core Qualification: Compulsory			

Course L0432: Signals and S	ystems
Тур	Lecture
Hrs/wk	3
СР	4
	Independent Study Time 78, Study Time in Lecture 42
Language Cycle	
Content	
	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.
<u> </u>	<u> </u>

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

Courses					
Title		Тур	Hrs/wk	СР	
ntroduction to Radiology and Radi	ation Therapy (L0383)	Lecture	2	3	
Module Responsible	Prof. Ulrich Carl				
Admission Requirements					
Recommended Previous Knowledge	None				
-	After taking part successfully, students	have reached the following learning results			
Professional Competence					
Knowledge					
	The students can distinguish different t	ypes of currently used equipment with respect	t to its use in radiation the	rapy.	
	The students can explain treatment pla	ns used in radiation therapy in interdisciplinar	y contexts (e.g. surgery, in	iternal medicine).	
	The students can describe the pati	ents' passage from their initial admittanc	e through to follow-up	care.	
	Diagnostics				
	The students can illustrate the technic	al base concepts of projection radiography, ir	actuding angiography and	mammography	
	well as sectional imaging techniques (C		iciuumg angiography and	manniography, a	
	The students can explain the diagnosti techniques.	c as well as therapeutic use of imaging techni	iques, as well as the techr	ical basis for thos	
	The students can choose the right treat	ment method depending on the patient's clinic	cal history and needs.		
	The student can explain the influence o	f technical errors on the imaging techniques.			
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.				
SKIIIS	Therapy The students can distinguish curative and palliative situations and motivate why they came to that conclusion.				
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.				
	The students can use the therapeutic principle (effects vs adverse effects)				
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).				
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups, social services, psycho-oncology).				
	Diagnostics				
	The students can suggest solutions for	repairs of imaging instrumentation after havin	a done error analyses		
	The students can classify results of in anatomy, pathology and pathophysiolog	naging techniques according to different grou gy.	ips of diseases based on	their knowledge	
Personal Competence					
Social Competence		cial situation of tumor patients and interact wit al, often fear-dominated behavior of sick pe ately.		-	
Autonomy	The students can apply their new know	ledge and skills to a concrete therapy case.			
hatehenny	The students can introduce younger stu				
	The students are able to access anator and acquire the relevant knowledge the	mical knowledge by themselves, can participa emselves.	te competently in convers	ations on the top	
Workload in House	Independent Study Time 62, Study Time	e in Lecture 28			
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	90 minutes				
scale Assignment for the	General Engineering Science (German r	program, 7 semester): Specialisation Biomedic	al Engineering: Compulsor	v	
Following Curricula		n program, 7 semester): Specialisation Me			
	Compulsory				
		edical Technology: Elective Compulsory n program, 7 semester): Specialisation Me	chanical Engineering Fo	cus Biomechanic	
	Compulsory	, program, , semestery, specialisation Me	Ligneering, FU	cas biomechanic	
	General Engineering Science (English p	rogram, 7 semester): Specialisation Biomedica	al Engineering: Compulsory	/	
	Mechanical Engineering: Specialisation		ve Compulsory		
		Medical Technology and Control Theory: Electi Management and Business Administration: Ele			
		Artificial Organs and Regenerative Medicine: E			

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0383: Introduction t	to Radiology and Radiation Therapy
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 of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments
Literature	• "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 – erschienen 08.12.2009
	ISBN: 978-3-437-47501-6
	"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus-
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	"Praxismanual Strahlentherapie" von Stöver / Feyer –
	1. Auflage - Springer-Verlag GmbH - erschienen 02.06.2000

Courses				
Title		Түр	Hrs/wk	СР
Introduction to Biochemistry and M	olecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe basic biomolecules; 			
	explain how genetic informatic	on is coded in the DNA;		
	explain the connection between	en DNA and proteins;		
	The should as he as a			
SKIIIS	The students can			
	 recognize the importance of m 	nolecular parameters for the course of a disease;		
	 describe selected molecular-di 	iagnostic procedures;		
	explain the relevance of these	procedures for some diseases		
Personal Competence				
•	The students can participate in discu	ssions in research and medicine on a technical leve	il.	
Autonomy	The students can develop understand	ding of topics from the course, using technical litera	ature, by themselves.	
Workload in Hours	Independent Study Time 62, Study Ti	ime in Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (Germa	n program, 7 semester): Specialisation Biomedical	Engineering: Compulsor	Ъ
Following Curricula	General Engineering Science (Gerr	man program, 7 semester): Specialisation Mech	anical Engineering, Fo	ocus Biomechanio
	Compulsory			
	Data Science: Specialisation Medicine	e: Compulsory		
	Electrical Engineering: Specialisation	Medical Technology: Elective Compulsory		
	Engineering Science: Specialisation B	Biomedical Engineering: Compulsory		
	General Engineering Science (English	n program, 7 semester): Specialisation Biomedical E	ingineering: Compulsory	/
	General Engineering Science (Engl	lish program, 7 semester): Specialisation Mech	anical Engineering, Fo	ocus Biomechani
	Compulsory			
	Mechanical Engineering: Specialisation	on Biomechanics: Compulsory		
	Biomedical Engineering: Specialisation	on Management and Business Administration: Electi	ve Compulsory	
	Biomedical Engineering: Specialisation	on Artificial Organs and Regenerative Medicine: Elec	ctive Compulsory	
	Biomedical Engineering: Specialisation	on Medical Technology and Control Theory: Elective	Compulsory	
	Biomedical Engineering: Specialisation	on Implants and Endoprostheses: Elective Compulso	ory	
	Technomathematics: Specialisation II	II. Engineering Science: Elective Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence	This module deals with the foundations of the fund	include of computing systems. It says	re the lower from	the ecompluie
Khowledge	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly- programming down to gates. The module includes the following topics:			
	Introduction			
Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Socurptial logic: Flip flops, automata, systematic hardware design			vorks	
	 Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division 			
	Basics of computer architecture: Programming	•	pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, or	caches		
	Input/output: I/O from the perspective of the Cl	PU, principles of passing data, point-to-	point connections,	busses
Skills	The students perceive computer systems from the ar	chitect's perspective, i.e., they identify	the internal struct	ure and the physi
	composition of computer systems. The students can			
	collection of few and simple components. They are a			
	today's computing systems - from gates and circuits	up to complete processors.		
	After successful completion of the module, the stud	ents are able to judge the interdenen	dencies between :	a physical compu
	system and the software executed on it. In particular			
	on the hardware-centric abstraction layers from the a			
	the impact that these low abstraction levels have on	an entire system's performance and to	propose feasible o	ptions.
Personal Competence				
-	Students are able to solve similar problems alone or i	n a group and to present the results ac	cordinaly	
Social competence	Students are able to solve similar problems alone of t	in a group and to present the results act	corunigiy.	
Autonomy	Students are able to acquire new knowledge from spe	cific literature and to associate this kno	owledge with other	classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	Compulsory Bonus Form De	scription		
	Yes 10 % Excercises			
	Written exam			
	90 minutes, contents of course and labs			
scale	General Engineering Science (German program, 7 ser	nostor), Enocialization Computer Science	compulsory	
	General Engineering Science (German program, 7 ser			rv
	General Engineering Science (German program, 7 ser			. ,
	General Engineering Science (German program, 7 ser	•		,
	General Engineering Science (German program, 7 ser	nester): Specialisation Biomedical Engi	neering: Compulso	ry
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Com General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Me		ing: Compulsory	
			ocus Mechatroni	
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	al Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering Foc	us Aircraft Svsto
	Engineering: Compulsory	semestery. Specialisation mechanical	Engineering, roe	as Allerate Syste
			cal Engineering.	
	General Engineering Science (German program,	7 semester): Specialisation Mechani		Focus Materials
	General Engineering Science (German program, Engineering Sciences: Compulsory	7 semester): Specialisation Mechani		Focus Materials
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory	nester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set	nester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng	neering, Focus Th gineering, Focus P	eoretical Mechani roduct Developm
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng	neering, Focus Th gineering, Focus P	eoretical Mechani roduct Developm
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical	neering, Focus Th gineering, Focus P Engineering, Focu	eoretical Mechani roduct Developm us Energy Syster
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical	neering, Focus Th gineering, Focus P Engineering, Focu	eoretical Mechani roduct Developm us Energy Syster
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical	neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	eoretical Mechani roduct Developm us Energy Syster
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical	neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	eoretical Mechani roduct Developm us Energy Syster
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 set	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical mester): Specialisation Civil Engineering	neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	eoretical Mechan roduct Developm us Energy Syster
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 set Computer Science: Core Qualification: Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical mester): Specialisation Civil Engineering	neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	eoretical Mechan roduct Developm us Energy Syster
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 set Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical mester): Specialisation Civil Engineering	neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory	eoretical Mechan roduct Developm us Energy System
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 set Engineering: Compulsory General Engineering Science (German program, 7 set and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 set Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory	mester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical mester): Specialisation Civil Engineering v rester): Specialisation Electrical Engineering	neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory ering: Compulsory Compulsory	eoretical Mechani roduct Developm us Energy Syster us Energy Syster

G	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
S	Sciences: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
а	and Production: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
0	Computational Science and Engineering: Core Qualification: Compulsory
N	Mechatronics: Core Qualification: Compulsory
Т	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Engineering		
Тур	ecture	
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: Computer Engineering	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1333: BIO I:	Implants and Fracture Healing	g		
	•			
Courses				
Title		Тур	Hrs/wk	СР
Implants and Fracture Healing (L03		Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
	It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students can describe the different way			
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.			i.
Skills	The students can determine the forces actin	g within the human body under quasi-static	situations under speci	fic assumptions.
Devenuel Commetence				
Personal Competence	The students can in groups, solve basis pun	parical modaling tacks for the calculation of i	internal forces	
Social Competence	The students can, in groups, solve basic nun	nerical modeling tasks for the calculation of i	internal forces.	
Autonomy	The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces.			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Mecha	anical Engineering, F	ocus Biomechanic
Following Curricula	Compulsory			
		am, 7 semester): Specialisation Biomedical E	Engineering: Compulso	ory
	Engineering Science: Specialisation Biomedi			
		am, 7 semester): Specialisation Biomedical El		-
		ogram, 7 semester): Specialisation Mecha	anical Engineering, F	ocus Biomechanio
	Compulsory			
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Artifi			
		ants and Endoprostheses: Elective Compulso		
		cal Technology and Control Theory: Elective		
	Biomedical Engineering: Specialisation Mana	agement and Business Administration: Electiv	ve Compulsory	
	Orientierungsstudium: Core Qualification: El	ective Compulsory		
	Technomathematics: Specialisation III. Engin	neering Science: Elective Compulsory		

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

	erical Mathematics I
Courses	
Title	Typ Hrs/wk CP
Numerical Mathematics I (L0417)	Lecture 2 3
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3
Module Responsible	Prof. Sabine Le Borne
Admission Requirements	None
Recommended Previous	. Mathamatik I. I. I. far Er eine eine Chadache (annen an en lich) an Arabaia C. Linne Alasher I. I. I. far Tachannathan athr
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematici basic MATLAB knowledge
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to
	name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root find
	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.
Skills	Students are able to
	 implement, apply and compare numerical methods using MATLAB,
	• justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
	 select and execute a suitable solution approach for a given problem.
Borconal Compotonco	
Personal Competence	Students are able to
Social Competence	
	 work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge working the perturbative of a logical state of the perturbative state of the perturbative of a logical state of the perturbative of the p
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms
Autonomy	Students are capable
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
	 to assess their individual progess and, if necessary, to ask questions and seek help.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
scale	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
ronowing carricula	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic Engineering: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering, Focus Theoretical Mechani Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I		
Тур	Lecture		
Hrs/wk	2		
CP	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
CP	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

Courses				
Title		Тур	Hrs/wk	СР
ntroduction to Physiology (L0385)		Lecture	2	3
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe the basics of the energy 	v metabolism:		
		n selected fields of muscle, heart/circulation, r	neuro- and sensory physic	ology.
			icare and sensory physi	0.0391
Skills		f basic bodily functions (sensory, transmission	n and processing of infor	mation, developm
	of forces and vital functions) and relate	them to similar technical systems.		
Personal Competence				
Social Competence		n research and medicine on a technical level.		
	The students can find solutions to problem	ems in the field of physiology, both analytical	and metrological.	
Autonomv	The students can derive answers to a	uestions arising in the course and other phys	siological areas, using te	chnical literature
	themselves.			
	Independent Study Time 62, Study Tim	e in Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the		program, 7 semester): Specialisation Biomedic		-
Following Curricula		n program, 7 semester): Specialisation Me	echanical Engineering, I	Focus Biomechan
	Compulsory			
	Data Science: Specialisation Medicine:			
		edical Technology: Elective Compulsory		
		medical Engineering: Elective Compulsory		
		n program, 7 semester): Specialisation Me	echanical Engineering, I	Focus Biomechan
	Compulsory	regreen 7 competer). Createlization Dismodia		
		rogram, 7 semester): Specialisation Biomedica rogram, 7 semester): Specialisation Biomedica		-
	Mechanical Engineering: Specialisation	-	ai Engineering. Elective C	lompuisory
		Medical Technology and Control Theory: Electi	ive Compulsory	
		Management and Business Administration: Elect		
		Artificial Organs and Regenerative Medicine: E		
		Implants and Endoprostheses: Elective Compu		
		Engineering Science: Elective Compulsory	,	

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

Courses		
Title	Typ Hrs/wk	СР
Experimental Methods in Biomecha	anics (L0377) Lecture 2	3
Module Responsible	Prof. Michael Morlock	
Admission Requirements	None	
Recommended Previous	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Metho	den".
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning 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 morphologic	es.
	The students can describe different measurement techniques for forces and movements, and choose the add	equate technique fo
	given task.	
Skills	5 The students can describe the basic handling of several experimental techniques used in biomechanics.	
Personal Competence		
Social Competence	The students can, in groups, solve basic experimental tasks.	
Autonomy	/ The students can, in groups, solve basic experimental tasks.	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Credit points	3	
Course achievement	t None	
Examination	Written exam	
Examination duration and	I 90 min	
scale	9	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,	Focus Biomechani
Following Curricula	Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compute	sory
	Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	Focus Biomechani
	Compulsory	A H (
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compuls General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective	-
	Mechanical Engineering: Specialisation Biomechanics: Compulsory	compuisory
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory	
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory	
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	

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

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	Typ Hrs/wk Cl	P
Computer Engineering (L0321)	Lecture 3 4	
Computer Engineering (L0324)	Recitation Section (small) 1 2	
Module Responsible	e Prof. Heiko Falk	
Admission Requirements		
Recommended Previous		
Knowledge		
Educational Objectives		
Professional Competence		
-	e This module deals with the foundations of the functionality of computing systems. It covers the layers from the e	accombly lo
Kilowieuge	programming down to gates. The module includes the following topics:	assembly-le
	Introduction	
	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks	
	 Sequential logic: Flip-flops, automata, systematic hardware design 	
	Technological foundations	
	Computer arithmetic: Integer addition, subtraction, multiplication and division	
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, caches	
	Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busse	es
Skills	/s The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure ar	nd the physi
	composition of computer systems. The students can analyze, how highly specific and individual computers can be b	ouilt based o
	collection of few and simple components. They are able to distinguish between and to explain the different abstra	action layers
	today's computing systems - from gates and circuits up to complete processors.	
	After successful second-tion of the second to the students are able to index the interval second second second s	
	After successful completion of the module, the students are able to judge the interdependencies between a physical structure and the concentration of the production of the students are able to judge the interdependencies between a physical structure and the concentration of the students are able to judge the interdependencies between a physical structure and the concentration of the students are able to judge the interdependencies between a physical structure and the concentration of the students are able to judge the interdependencies between a physical structure and the concentration of the students are able to judge the interdependencies between a physical structure and the structure	
	system and the software executed on it. In particular, they shall understand the consequences that the execution of	
	on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabl	In all has accorded.
	the impact that these low abstraction lovels have an an entire system's performance and to propose feasible entires	
	the impact that these low abstraction levels have on an entire system's performance and to propose feasible options	
Personal Competence		
Social Competence	e e Students are able to solve similar problems alone or in a group and to present the results accordingly.	s.
Social Competence	e	s.
Social Competence	 e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class 	s.
Social Competence Autonomy Workload in Hours	 e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 	s.
Social Competence Autonomy Workload in Hours Credit points	 e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 	s.
Social Competence Autonomy Workload in Hours	 e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement	e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 t Compulsory Bonus Form Description	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 t Compulsory Bonus Form Description Yes 10 % Excercises	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	e c f Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 t Compulsory Bonus Form Description Yes 10 % Excercises n Written exam g 90 minutes, contents of course and labs	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	e e e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 t Compulsory Bonus Form Description Yes 10 % Excercises n Written exam g 90 minutes, contents of course and labs	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	 ke version of the second second	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 ke of the second second	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 ke of the second second	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 ke of the second second	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 ke of the second second	s.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 k Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 c Compulsory Bonus Form Description Yes 10 % Excercises m Written exam 90 minutes, contents of course and labs e General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory 	ses.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 k k	ses.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class Independent Study Time 124, Study Time in Lecture 56 6 Compulsory Bonus Form Description Yes 10 % Excercises Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory<	ses.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 Students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class Independent Study Time 124, Study Time in Lecture 56 6 Compulsory Bonus Form Description Yes 10 % Excercises Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compuls	ses.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 Students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class Independent Study Time 124, Study Time in Lecture 56 6 Compulsory Bonus Form Description Yes 10 % Excercises Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: C General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: C General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: C General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory 	s. ses.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 t Compulsory Bonus Form Description Yes 10 % Excercises n Written exam d 90 minutes, contents of course and labs e General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory general Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: C	ses.
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	e Students are able to solve similar problems alone or in a group and to present the results accordingly. y Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class s Independent Study Time 124, Study Time in Lecture 56 s 6 t Compulsory Bonus Form Description Yes 10 % Excercises n Written exam d 90 minutes, contents of course and labs e General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory general Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical	s. ses. Compulsory Mechatron Biomechan
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	 students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from specific literature and to associate this knowledge with other class Independent Study Time 124, Study Time in Lecture 56 6 Compulsory Bonus Form Description Yes 10% Excercises M Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: C General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: C General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: C General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: C General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Compulsory	s. ses. Compulsory Mechatron Biomechan

	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
	and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
	Compulsory
	Computer Science: Core Qualification: Compulsory
	Electrical Engineering: Core Qualification: Compulsory
	General Engineering Science (English program, 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
	Technomathematics: specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	lineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 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
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		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			
Recommended Previous	Mathematics 1-3			
Knowledge				
	The modul is an introduction to the theory of signals a			
	1-3 is expected. Further experience with spectral tra	ansformations (Fourier series, Fourier tra	ansform, Laplace	e transform) is us
	but not required.			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signal	s and linear time-invariant (LTI) systems	using methods	of signal and syst
	theory. They are able to apply the fundamental tran	sformations of continuous-time and disc	rete-time signal	s and systems. T
	can describe and analyse deterministic signals and	systems mathematically in both time a	nd image domai	n. In particular, t
	understand the effects in time domain and image of	domain which are caused by the transi	tion of a continu	ious-time signal t
	discrete-time signal.			
Skills	The students are able to describe and analyse detern	ninistic signals and linear time-invariant	systems using n	nethods of signal
	system theory. They can analyse and design basi	-		-
	response, stability, linearity etc They can assess the	impact of LTI systems on the signal pro	perties in time a	nd frequency dom
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
	The students are able to acquire relevant informa	ation from appropriate literature sourc	es They can c	ontrol their leve
	knowledge during the lecture period by solving tutori			
Workload in Hours	Independent Study Time 110, Study Time in Lecture			
Credit points				
Course achievement				
Examination				
Examination duration and	90 min			
scale				
	General Engineering Science (German program, 7 ser			У
Following Curricula	General Engineering Science (German program, 7 ser			
	General Engineering Science (German program, 7 ser			
	General Engineering Science (German program, 7 ser			-
	General Engineering Science (German program, 7 ser			
	General Engineering Science (German program, 7	7 semester): Specialisation Mechanica	l Engineering, I	Focus Biomechan
	Compulsory			_
	General Engineering Science (German program, 7	semester): Specialisation Mechanical I	Engineering, Foo	us Energy Syste
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Syste
	Engineering: Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program,	/ semester): Specialisation Mechanica	il Engineering,	Focus Mechatron
	Compulsory			
	General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical Engir	neering, Focus II	neoretical Mechan
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 sem			
	General Engineering Science (English program, 7 sem			
	General Engineering Science (English program, 7 sem			
	General Engineering Science (English program, 7 sem			
	General Engineering Science (English program, 7 sem General Engineering Science (English program, 7			
	Compulsory	semester). Specialisation Mechanica	i Liigineering, i	ocus biomecnan
	General Engineering Science (English program, 7	semester): Specialisation Mechanical R	Engineering For	us Energy Syste
	Compulsory	semestery. Specialisation mechanical i	ingineering, roc	us Energy Syste
	General Engineering Science (English program, 7	semester): Specialisation Mechanical	Engineering For	us Aircraft Svet
	Engineering: Compulsory		, iocimy, ioc	
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engine	eering. Focus Ma	terials in Enginee
	Sciences: Compulsory		, i ocus Ma	ele in Engineer
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering	Focus Mechatron
	Compulsory	semestery, specialisation mechaliled	. Engineering,	. Jeas meenau un
	General Engineering Science (English program, 7 ser	mester): Specialisation Mechanical Engin	eering Focus Th	neoretical Mechan
	Engineering: Compulsory			
	Engineering: Compulsory	cation: Compulsory		
	Engineering: Compulsory Computational Science and Engineering: Core Qualific Mechatronics: Core Qualification: Compulsory	cation: Compulsory		

Course L0432: Signals and S	ystems
Тур	Lecture
Hrs/wk	3
СР	4
-	
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.
	L

Course 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		Тур	Hrs/wk	СР
Heat Transfer (L0458) Heat Transfer (L0459)		Lecture Recitation Section (large)	3 2	4 2
	Dr. Andross Moschallski	Recitation Section (large)	Z	Z
Admission Requirements	Dr. Andreas Moschallski None			
Recommended Previous		nics		
Knowledge	rechined memodynamics i, ir and ridid Dynam			
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of F	leat Transfer,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a	critical way		
	- to unaryse connex near transfer processes in a	critical way.		
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer	processes,		
	- solve excersises self-consistent and in small gr	roups.		
Demonstration of the second				
Personal Competence	The students are able to discuss in small groups	and dovelon an approach		
Social Competence	The students are able to discuss in small groups			
Autonomy	The students are able to develop a complex pro	blem self-consistent and analyse the results	in a critical way.	A qualified exchan
	with other students is given.			
Workload in Hours	Independent Study Time 110, Study Time in Leo	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program	m, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
Following Curricula	Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Biomedical Engir	neering: Compulso	ory
	General Engineering Science (German program,	, 7 semester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (German program, Engineering: Compulsory	, 7 semester): Specialisation Mechanical Engl	neering, Focus Tr	ieoretical Mechani
	Energy Systems: Technical Complementary Cou	rse Core Studies: Elective Compulsory		
	General Engineering Science (English program,		neering, Focus Th	eoretical Mechani
	Engineering: Elective Compulsory		<u> </u>	
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory			
	General Engineering Science (English program,		eering: Compulso	ry
	Mechanical Engineering: Specialisation Energy S Mechanical Engineering: Specialisation Theoreti			

Course 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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (L(235)	Lecture	2	3
Computational Fluid Dynamics I (LC		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mathematical Methods for Engineers			
	 Fundamentals of Differential/integral calculus and 	series expansions		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of partia	al differential equations.		
Skills	The students are able develop appropriate numerical in	tegration in space and time for the go	verning partial di	fferential equatio
	They can code computational algorithms in a structured	way.		
Personal Competence				
	The students can arrive at work results in groups and do	ocument them.		
Autonomy	The students can independently analyse approaches to	solving specific problems.		
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination				
Examination duration and	2h			
scale				
	General Engineering Science (German program, 7 seme			ing: Compulsory
Following Curricula	General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 se			is Enorgy System
	Elective Compulsory	mester). Specialisation Mechanical i	ingineering, rocc	is Lifergy Syster
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical F	Engineering. Focu	is Energy System
	Compulsory		J	
	General Engineering Science (German program, 7 s	emester): Specialisation Energy and	Enviromental Er	ngineering: Elect
	Compulsory			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engir	eering, Focus The	eoretical Mechani
	Engineering: Elective Compulsory			
	Energy Systems: Technical Complementary Course Core			
	General Engineering Science (English program, 7 se	emester): Specialisation Energy and	Enviromental Er	ngineering: Elect
	Compulsory			<u> </u>
	General Engineering Science (English program, 7 semes			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical E	ngineering, Focu	is Energy Syster
	Elective Compulsory General Engineering Science (English program, 7 semes	ter): Specialisation Naval Architecture	Compulsory	
	Mechanical Engineering: Specialisation Energy Systems		. compulsory	
		e company,		
	Naval Architecture: Core Qualification: Compulsory			

Course L0235: Computationa	al Fluid Dynamics I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	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

Course L0419: Computationa	urse 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				
		_		
Title		Тур	Hrs/wk	CP
1 5 5	ines and Turbomachinery - Part Reciprocating Engines (L0633)	Lecture Recitation Section (large)	1	1 1
	ines and Turbomachinery - Part Reciprocating Engines (L0634)		2	
Internal Combustion Engines I (L00 Internal Combustion Engines I (L06		Lecture Recitation Section (large)	1	2
		Rectation Section (large)	-	L
	Prof. Christopher Friedrich Wirz None			
Admission Requirements				
	Thermodynamics, Mechanics, Machine Elements			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	As a result of the part module "Fundamentals of Reciprocatin	g Machinery", the students are a	able to reflect fur	damentals regard
	power and working machinery and describe the qualitative a	and quantitative correlations of c	operating method	s and efficiencies
	multiple types of engines, compressors and pumps. They a	re able to utilize technical term	s and parameter	s as well as aspe
	regarding the development of power density and efficience	y, furthermore to give an over	view of charging	systems, fuels a
	emissions. The students are able to select specific types of m	achinery and assess design relat	ted and operation	nal problems.
	As a result of the part module "Internal Combustion Engi			
	regarding efficiency limits. In addition, they are able to	-	-	-
	characteristics and the approach of similarity. They are able	to explain, assess and develop	engines as well a	is charging syster
	Detailed knowledge is present regarding computer-aided pro	cess design.		
CI-III-	The shudents are alithed to even by hereis and date it because			
SKIIIS	The students are skilled to employ basic and detail knowled			
	They are further able to assess, analyse and solve tec	nnical and operational problem	ns and to perfo	rm mechanical a
	thermodynamic design.			
Personal Competence				
Social Competence	The students are able to communicate and cooperate in	a professional environment in	the field of ma	achinery design a
	application.			
Autonomy	The widespread scope of gained knowledge enables the stud	lents to handle situations in their	r future professio	n independently a
Autonomy	confidently.		ruture professio	in independentity (
	connuently.			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement Examination				
Examination Examination duration and				
scale	120 (1)(1)			
	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical I	Engineering Foc	us Energy System
Following Curricula		server appendituation mechanical i	Lighteening, 100	as Energy Syster
Following Curricula		lactive Compulsor		
	Energy and Environmental Engineering: Core Qualification: E			
	Energy Systems: Technical Complementary Course Core Stud			_
	General Engineering Science (English program, 7 semest	er): Specialisation Mechanical E	Engineering, Foc	us Energy Syster
	Compulsory			

	s of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines
Тур	
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Christopher Friedrich Wirz
Language	DE
Cycle	WiSe
Content	- Verbrann un annakaran
	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 Tichtelkens und Versund versichters
	Einteilung und Verwendung Kelbensumsen
	Kolbenpumpen
	Prinzip der Kolbenpumpen Tinteilung und Vorwandung
	Einteilung und Verwendung
Literature	
	A. Urlaub: Verbrennungsmotoren
	W. Kalide: Kraft- und Arbeitsmaschinen

Course L0634: Fundamentals	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 Comb	oustion Engines I
Тур	Lecture
Hrs/wk	2
CP	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 Comb	ourse L0639: Internal Combustion Engines I	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	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				
itle		Тур	Hrs/wk	СР
dvanced Mechanical Engineering	Design II (L0264)	Lecture	2	2
dvanced Mechanical Engineering	Design II (L0265)	Recitation Section (large)	2	1
dvanced Mechanical Engineering		Lecture	2	2
dvanced Mechanical Engineering	Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous	Fundamentals of Mechanical Engine	eering Design		
Knowledge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	After passing the module, students are ab	ole to:		
	explain complex working principles	and functions of machine elements and of basic ele	ments of fluidics,	
	• explain requirements, selection crit	teria, application scenarios and practical examples o	f complex machir	ne elements,
	 indicate the background of dimensional dimensi 	ioning calculations.		
Chille	After passing the module, students are all	le te.		
SKIIIS	After passing the module, students are ab	lie to:		
	accomplish dimensioning calculation	ons of covered machine elements,		
	 transfer knowledge learned in the r 	module to new requirements and tasks (problem solv	/ing skills),	
	 recognize the content of technical of 	drawings and schematic sketches,		
	evaluate complex designs, technica	ally.		
Personal Competence				
Social Competence				
Social competence	Students are able to discuss technic	cal information in the lecture supported by activating	g methods.	
Autonomy				
Autonomy	Students are able to independently	deepen their acquired knowledge in exercises.		
	 Students are able to acquire addit 	ional knowledge and to recapitulate poorly underst	tood content e.g.	by using the vio
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time in	n Lecture 112		
Credit points				
Course achievement				
Examination duration and	120			
scale				
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mechanical Engine	eering: Compulso	iry
		pgram, 7 semester): Specialisation Mechanical Engin program, 7 semester): Specialisation Mechanical		
	General Engineering Science (German Compulsory		Engineering, F	ocus Biomechan
	General Engineering Science (German Compulsory	program, 7 semester): Specialisation Mechanical	Engineering, F	ocus Biomechan
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory	program, 7 semester): Specialisation Mechanical	Engineering, Fo	ocus Biomechan us Energy Syster
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E	Engineering, Fo	ocus Biomechan us Energy Syster
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E	Engineering, Focu	ocus Biomechan us Energy Syster us Aircraft Syste
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanic	Engineering, Focu Engineering, Focu Engineering, Focu al Engineering,	ocus Biomechan us Energy Syster us Aircraft Syste Focus Materials
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical I	Engineering, Focu Engineering, Focu Engineering, Focu al Engineering,	ocus Biomechan us Energy Syster us Aircraft Syste Focus Materials
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German Compulsory	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanica program, 7 semester): Specialisation Mechanica	Engineering, Focu Engineering, Focu Engineering, Focu al Engineering, F I Engineering, F	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials ocus Mechatroni
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro-	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanic	Engineering, Focu Engineering, Focu Engineering, Focu al Engineering, F I Engineering, F	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials ocus Mechatroni
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro and Production: Compulsory	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanica program, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechanical Engi	Engineering, Fo Engineering, Focu Engineering, Focu al Engineering, I Engineering, F neering, Focus Pi	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developm
	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro and Production: Compulsory General Engineering Science (German pro	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanica program, 7 semester): Specialisation Mechanica	Engineering, Fo Engineering, Focu Engineering, Focu al Engineering, I Engineering, F neering, Focus Pi	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developm
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	General Engineering Science (German Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro and Production: Compulsory General Engineering Science (German pro Engineering: Compulsory General Engineering Science (German pro Engineering: Compulsory Energy Systems: Technical Complemental	program, 7 semester): Specialisation Mechanical program, 7 semester): Specialisation Mechanical E program, 7 semester): Specialisation Mechanical I program, 7 semester): Specialisation Mechanica program, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechanical Engi pogram, 7 semester): Specialisation Mechanical Engin	Engineering, Fo Engineering, Focu Engineering, Focu al Engineering, I Engineering, F neering, Focus Pi	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developm
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Engineering: Compulsory Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

Course L0264: Advanced Me	chanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	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.
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	 Konstruktionsteine, Pani, 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, aktueli
	 Maschineheremente - Gestaltung, Berechnung, Anwendung, Haberhauer, H., Bouenstein, F., Springer-verlag, aktuelik Auflage.
	 Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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

Course L0262: Advanced Me	chanical 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
	Gear drives
	• Epicyclic gears
	• Crank gears
	 Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	- Dubbel Tasebashush für den Masshinanhaur Grete K. U. Faldhusen I. (Urse). Caringer Verlag, aldusla Auflage
	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, aktuel
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

Course 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					
Fitle			Тур	Hrs/wk	СР
Gas and Steam Power Plants (L020	6)		Lecture	3	5
Gas and Steam Power Plants (L021			Recitation Section (large)	1	1
Module Responsible	NN				
Admission Requirements	None				
Recommended Previous					
Knowledge	 "Technical The 	rmodynamics I and II"			
	 "Heat Transfer 	11			
	 "Fluid Mechanic 	cs"			
Educational Objectives	After taking part succ	essfully students have re	ached the following learning results		
Professional Competence	Arter taking part sact	costany, stadents have re			
-	The students can ev	aluate the development of	of the electricity demand and the energy	conversion routes i	in the thermal nov
Kilowieuge					
	-		t and the layout of the steam generator bl	-	
	-		. Additionally they can describe the ext		
		n Capture and Storage.	I-fuelled power plants with solar thermal	and geothermal po	ower plants of pla
	equipped with Carbo	i Capture and Storage.			
	The students have ba	sic knowledge about the p	principles, operation and design of turboma	chinery	
Chille	The students will be	able using theories and	matheda of the operative technology from	feed fuels and be	and an well found
SKIIIS			methods of the energy technology from		
	-		gas and steam power plants, to identify bas		
	-		olutions. Through analysis of the problem	-	
		-	ints are endowed with the capability and r		
			he production of heat. From the technical b		
			y mix composition within the energy-politic	al triangle (econom	ny, secure supply a
	environmental protec	tion).			
	Within the framework	of the exercise the stude	nts learn the use of the specialised softwar	e suite EBSII ON Pro	fessional TM With
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM . With th tool small practical tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.				
	tool small practical tasks are solved with the PC, to highlight aspects of the design and development of power plant cycles.				
	The students are abl	e to do simplified calculat	ions on turbomachinery either as part of a	a plant, as single co	omponent or at sta
	level.				
Devecuel Commetence					
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 dire contact with a modern power plant in this region. The students will obtain first-hand experience with a power plant in operati				
				perience with a pov	ver plant in operat
			hnical and political issues.		
Autonomy			to develop alone simple simulation models		
			wledge from the lecture is consolidated		
			ns highlighted. The students are able inc		alyse the operatio
	performance of steam power plants and calculate selected quantities and characteristic curves.			irves.	
Workload in Hours	Independent Study T	me 124, Study Time in Le	cture 56		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	No 5 %	Attestation	15-minütiges, unbenotetes Testat		Professional; r
			bestanden/nicht bestanden (keine ante	5	
	No 5 %	Excercises	10 Übungsaufgaben im Laufe der Vorle	sungen à 5 Minuter	n; bis zu 5 % Bonus
			nach Anteil richtiger Abgaben		
Examination					
Examination duration and	Written examination	of 120 min			
scale					
-		Science (German progra	am, 7 semester): Specialisation Energy a	and Enviromental	Engineering: Elect
Following Curricula					_
		Science (German progra	im, 7 semester): Specialisation Mechanica	al Engineering, Foo	cus Energy Syster
	Elective Compulsory				
			ualification: Elective Compulsory		
			urse Core Studies: Elective Compulsory		
		Science (English progra	m, 7 semester): Specialisation Energy a	and Enviromental I	Engineering: Elect
	Compulsory				
		Science (English progra	m, 7 semester): Specialisation Mechanica	al Engineering, Foo	cus Energy Syster
	Elective Compulsory				
	Elective compulsory				

Course L0206: Gas and Stear	m Power Plants		
Тур	Lecture		
Hrs/wk	3		
CP	5		
Workload in Hours	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 plant		
	Construction materials for power plants		
	Location of power plants		
	Solar thermal plants/geothermal plants/Carbon Capture and Storage plants.		
	These are complemented in the 2 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		
	Characteristic numbers		
	Axial and radial design		
	Design features		
	Hydraulic turbomachines		
	Pump and water turbine designs		
	Design examples of reciprocating engines and turbomachinery		
	Steam power plants		
	Gas turbine systems.		
Literature	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		
	induction activities, recallisation very reach, very rov nincing ind		

ourse L0210: Gas and Stear	n Power Plants
Тур	Recitation Section (large)
Hrs/wk	
CP	1
	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 plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	 Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO $_2$ emissions and the resulting climatic effects are a special focus
	the lecture and the lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants a renewable energy sources are discussed and the technical options for providing security of supply and network stability a presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's o actions are emphasized and the potential extent of the different solutions presented clearly.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM . With tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The stude present their results orally and can afterwards ask questions and get feedback. The course work has a positive effect on students final grade.
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, Heizkraftwerke u Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Courses				
Title		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Indust	ry (L0315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
	distribution and power trading wih rega	curring in this context. Furthermore, they can expl ard to subject-related contexts. The students of eneral, especially for renewable energy systems a al benefits from the use of such systems.	an explain these	aspects, which
Skills	Skills Students are able to apply methodologies for detailed determination of energy demand or energy production for var energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable en			ally and design th rules, also for
	and to put them them into the right conte		The field of feller	wable energies of
Personal Competence				
Social Competence		e technical alternatives and to assess them with allows them to make an effective contribuition to a		
Autonomy	Students can independently exploit source	ces , acquire the particular knowledge about the	subject area and	transform it to
	questions.		,	
	Independent Study Time 96, Study Time in	n Lecture 84		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and	3 hours written exam			
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Energy and Env	riromental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German pro	gram, 7 semester): Specialisation Process Engine	ering: Compulsory	
	General Engineering Science (German p	program, 7 semester): Specialisation Mechanical	Engineering, Foo	us Energy Syste
	Elective Compulsory			
	General Engineering Science (German p	program, 7 semester): Specialisation Mechanical	Engineering, Foo	us Energy Syste
	Compulsory		-	
		cialisation Civil Engineering: Elective Compulsory		
		cialisation Traffic and Mobility: Elective Compulsory	rv	
		cialisation Water and Environment: Elective Compuso	-	
			vuisor y	
	Energy and Environmental Engineering: Co			
		gram, 7 semester): Specialisation Energy and Envi	-	
		rogram, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syste
	Elective Compulsory			
	General Engineering Science (English prog	gram, 7 semester): Specialisation Process Enginee	ring: Elective Com	pulsory

Course L0316: Power Industr	у
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 electricity generation 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 Cost and efficiency calculation
Literature	Folien der Vorlesung

Course L0315: Energy Systems and Energy Industry			
Тур	Lecture		
Hrs/wk	2		
CP	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: Renewable Er	nergy
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 Er	nergy
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
	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		Engineering Design			
.041303					
Гitle			Тур	Hrs/wk	СР
Advanced Mechanical Engineering			Lecture	2	2
Advanced Mechanical Engineering			Recitation Section (large)	2	1
Advanced Mechanical Engineering Advanced Mechanical Engineering			Lecture Recitation Section (large)	2	2 1
			Recitation Section (large)	2	Ŧ
Module Responsible					
Admission Requirements Recommended Previous	None				
Kecommended Previous Knowledge	 Fundamentals of M 	lechanical Engineering Design			
Kilowieuge	 Mechanics 				
	 Fundamentals of M 	laterials Science			
	 Production Engine 	ering			
Educational Objectives	After taking part success	fully, students have reached th	ne following learning results		
Professional Competence	Arter taking part success	any, students have reached th	le following learning results		
-	After passing the module	students are able to:			
Kilowieuge	Arter passing the module	, students are able to.			
	 explain complex w 	orking principles and function	s of machine elements and of basic el	ements of fluidics,	,
	 explain requireme 	nts, selection criteria, applicat	ion scenarios and practical examples	of complex maching	ne elements,
	 indicate the backg 	round of dimensioning calcula	tions.		
Skills	After passing the module	. students are able to:			
		sioning calculations of covered			
	_		v requirements and tasks (problem so	lving skills),	
	-	tent of technical drawings and	schematic sketches,		
	evaluate complex	designs, technically.			
Personal Competence					
Social Competence					
	 Students are able 	to discuss technical informatio	n in the lecture supported by activation	ng methods.	
Autonomy					
			acquired knowledge in exercises.		
			dge and to recapitulate poorly under	stood content e.g	. by using the vi
	recordings of the I	ectures.			
	l				
Workload in Hours	Independent Study Time	68, Study Time in Lecture 112			
Workload in Hours Credit points		68, Study Time in Lecture 112			
	6	68, Study Time in Lecture 112			
Credit points	6 None	68, Study Time in Lecture 112			
Credit points Course achievement	6 None Written exam	68, Study Time in Lecture 112			
Credit points Course achievement Examination	6 None Written exam	68, Study Time in Lecture 112			
Credit points Course achievement Examination Examination duration and scale	6 None Written exam 120			Engineering, Foc	us Aircraft Svste
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 120	ience (German program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 120 General Engineering Sci Engineering: Compulsory	ience (German program, 7 s			
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 120 General Engineering Sci Engineering: Compulsory	ience (German program, 7 s , cience (German program, 7	emester): Specialisation Mechanical		
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Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 120 General Engineering Sci Engineering: Compulsory General Engineering Sci Engineering Sciences: Co	ience (German program, 7 s , cience (German program, 7 mpulsory	emester): Specialisation Mechanical semester): Specialisation Mechani	cal Engineering,	Focus Materials
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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: Advanced Mee	chanical 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			
Content	Advanced Mechanical Engineering Design I & II			
	Lecture			
	Lecture			
	Fundamentals of the following machine elements:			
	Linear rolling bearings			
	• Axes & shafts			
	• Seals			
	Clutches & brakes			
	Belt & chain drives			
	Gear drives			
	Epicyclic gears			
	Crank drives			
	 Sliding bearings 			
	Elements of fluidics			
	Exercise			
	Calculation methods of the following machine elements:			
	 Linear rolling bearings 			
	Axes & shafts			
	Clutches & brakes			
	Belt & chain drives			
	Gear drives			
	• 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 - 2, Schlecht, B., realson verlag, accele Aunage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuel 			
	Auflage.			
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.			
	Sowie weitere Bücher zu speziellen Themen			

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

Warkadi Naur 1000000000000000000000000000000000000	Тур	Lecture
co 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Dieter Krause, Prof. Otto von Estorff Languago DE Cycte WiSe Content Advanced Mechanical Engineering Design 1 & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Outches & brakes Belt & chain drives Gear drives Elerverike Claculation methods of the following machine elements: Linear solling bearings Elements of fluidics Exercise Claculation methods of the following machine elements: Linear of fluidics Exercise Claculation methods of the following machine elements: Linear of fluidics Exercise Claculation set of starks Belt & chain drives Gear drives Elerveitic gears Stidling bearings Claculation so flydrostatic systems (fluidics) Claculations of hydrostatic systems (fluidics) Literature Dubbel, Taschenbuch für den Maschinenbau, Grote, KM., Fledhusen, J.(Hrsg.): Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band HI, Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band HI, Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band HI, Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band, HI, Stephere, Verlag, aktuelle		
Lecture Prof. Dieter Krause, Prof. Otto von Estorff Language DE Cycte Wise Context Advanced Mechanical Engineering Design 1 & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Ares & shafts Seals Clutches & brakes Belt & chain drives Gear drives Gear drives Gear drives Gear drives Gear drives Siding bearings Ares & shafts Clutches & brakes Ilements of fluidics Exercise Calculation methods of the following machine elements: Unear rolling bearings Ares & shafts Clutches & brakes Belt & chain drives Gear drives Siding bearings Ares & shafts Clutches & brakes Belt & chain drives Gear drives		2
Lecture Prof. Dieter Krause, Prof. Otto von Estorff Language DE Cycte WiSe Context Advanced Mechanical Engineering Design I & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Ares & shafts Seals Clutches & brakes Gear drives Gear drives Gear drives Gear drives Gear drives Solding bearings Icrank drives Sidling bearings Calculation methods of the following machine elements: Unear rolling bearings Calculation methods of the following machine elements: Unear rolling bearings Ares & shafts Clutches & brakes Belt & chain drives Gear drives Gear drives Gear drives Gear drives Gear drives Clutches & brakes Belt & chain drives Gear drives<td>Workload in Hours</td><td>Independent Study Time 32, Study Time in Lecture 28</td>	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Language DE Cycle WiSe Context Advanced Mechanical Engineering Design I & II Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Elements of fluidics Exercise • Belt & chain drives • Silding bearings • Crank drives • Silding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Literature • 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 • Clutches & brakes • Gear drives • Clutches & Clutes & Clutes • Clutches & Clutes • Clutes • Clutes • Clutches & Clutes •		
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Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.		
		Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course 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				
Courses				
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4
Signals and Systems (L0432)		Recitation Section (small)	2	2
	Prof. Gerhard Bauch			
Admission Requirements	None			
-	Mathematics 1-3			
Knowledge				
5	The modul is an introduction to the theory of signals a		-	
	1-3 is expected. Further experience with spectral tran	nsformations (Fourier series, Fourier tr	ansform, Laplace	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals	and linear time-invariant (LTI) system	s using methods	of signal and syste
	theory. They are able to apply the fundamental trans	formations of continuous-time and dis	crete-time signals	s and systems. Th
	can describe and analyse deterministic signals and s	ystems mathematically in both time a	and image domai	n. In particular, th
	understand the effects in time domain and image de	omain which are caused by the trans	ition of a continu	ous-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determ	inistic signals and linear time-invariant	systems using m	nethods of signal a
	system theory. They can analyse and design basic			
	response, stability, linearity etc They can assess the	impact of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence				
	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant informa			ontrol their level
	knowledge during the lecture period by solving tutoria	l problems, software tools, clicker syste	em.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Electrical Engine	ering: Compulsor	ý
Following Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 sem	ester): Specialisation Process Engineer	ring: Compulsory	
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	al Engineering, F	ocus Biomechani
	Compulsory		Facility of the Fac	
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
	Compulsory	competer), Englishing Machanical	Engineering Eq.	aug Aircraft System
	General Engineering Science (German program, 7 : Engineering: Compulsory	semester): specialisation Mechanical	Engineering, Foc	us Aircrait Syster
	General Engineering Science (German program, 7	(comostor): Specialisation Mechani		Focus Matorials
	Engineering Sciences: Compulsory	semester). Specialisation Mechani	.ai Liigineering,	Tocus Materials
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering	Focus Mechatroni
	Compulsory	semestery. Specialisation mechanic	in Engineering, i	focus meenationi
	General Engineering Science (German program, 7 sen	nester): Specialisation Mechanical Engi	neering. Focus Th	eoretical Mechani
	Engineering: Compulsory		incenting, i beab ii	
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 sem	ester): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (English program, 7 sem	ester): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 sem	ester): Specialisation Bioprocess Engine	eering: Compulso	ry
	General Engineering Science (English program, 7 seme	ester): Specialisation Biomedical Engine	eering: Compulso	ry
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	I Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
	Compulsory			
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Aircraft System
	Engineering: Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engin	eering, Focus Ma	terials in Engineeri
	Sciences: Compulsory			
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	al Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Computational Science and Engineering: Core Qualification Mechatronics: Core Qualification: Compulsory	ation: Compulsory		

Course L0432: Signals and S	vstems
Тур	
Hrs/wk	
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Language	
Cycle	
	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 and S	ystems
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	
	The Hardwide CD
Title Advanced Mechanical Design Proje	ct (L0266) Typ Hrs/wk CP ct (L0266) Project-/problem-based Learning 4 6
Module Responsible	
Admission Requirements	None
Recommended Previous Knowledge	Mechanical Engineering: Design
Kilowieuge	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
-	After passing the module, students are able to:
	express the procedure for systematically handling of
	complex design tasks ,
	 describe working principles, their use and combination possibilities,
	 explain guidelines for designing for function and manufacturing,
	 explain advanced use-oriented knowledge of machine elements.
Skills	After passing the module, students are able to:
	 analyze complex tasks and develop principle solutions using sketches,
	convert principle solutions into a detailed design,
	use methods to design and solve engineering design tasks systematically and solution-oriented,
	create a technical documentation including all necessary technical drawings to understand the functions of the system,
	 document calculations of selected machine elements clearly and in detail.
Personal Competence	
	After passing the module, students are able to:
	 present and discuss solutions and technical drawings within groups, as fact the sum as able is the sum of a fact the sum of the
	reflect the own results in the work groups of the course
Autonomy	After passing the module, students are able to:
	 independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select
	appropriate methods,
	to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
	Yes None Attestation
Examination	Written exam
Examination duration and	180
scale	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
Following Curricula	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani
	Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Compulsory
	Mechanical Engineering: Core Qualification: Compulsory

Course L0266: Advanced Med	chanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
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		Тур	Hrs/wk	СР
Simulation and Design of Mechatro	nic Systems (L1822)	Lecture	2	2
Simulation and Design of Mechatro	nic Systems (L1823)	Recitation Section (large)	1	2
Simulation and Design of Mechatro	nic Systems (L1824)	Practical Course	1	2
Module Responsible	Prof. Uwe Weltin			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory and	electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calcu	llations for design, modeling, simulation and	optimization of n	nechatronic system
Skills	Students are able to apply modern algorithms for	r modeling of mechatronic systems. They ca	an identify, simula	ate and design sim
	systems and implement those in laboratory cond		,,, ,,	
Personal Competence				
Social Competence	Students are able to work goal-oriented in small	mixed groups and present results to target	groups.	
Autonomy	Students are able to recognize and improve know	wledge deficits independently.		
	With instructor assistance, students are able to e		ne a further cours	e of study.
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points				
Course achievement	None			
Examination				
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German progra	im, 7 semester): Specialisation Mechanic	al Engineering,	Focus Mechatroni
Following Curricula	Compulsory	- 7 competer), Creciplication Machanical		aug Airgraft Custo
	General Engineering Science (German program Engineering: Compulsory	n, 7 semester): specialisation Mechanical	Engineering, Fo	LUS AITCIAIL SYSLE
	Digital Mechanical Engineering: Core Qualificatio	n: Compulsory		
	General Engineering Science (English program		Engineering, Fo	cus Aircraft Syste
	Engineering: Compulsory	,,,	J -	
	General Engineering Science (English progra	m, 7 semester): Specialisation Mechanic	al Engineering,	Focus Mechatroni
	Compulsory			
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Eng	neering, Focus Th	neoretical Mechani
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation Aircraft S			
	Mechanical Engineering: Specialisation Mechatro			
	Mechanical Engineering: Specialisation Theoretic			
	Mechanical Engineering: Specialisation Theoretic	al Mechanical Engineering: Elective Compul	sory	

Course L1822: Simulation and Design of Mechatronic Systems			
Тур	Lecture		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Uwe Weltin		
Language	DE		
Cycle	WiSe		
Content	Mechatronic Design		
	Modeling		
	odel Identifikation		
	umerical Methods in simulation		
	Applications and examples in Matlab $^{\circledast}$ and Simulink $^{\circledast}$		
Literature	Skript zur Veranstaltung		
	Weitere Literatur in der Veranstaltung		

ourse L1823: Simulation and Design of Mechatronic Systems			
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Uwe Weltin		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		
Course L1824: Simulation an	d Design of Mechatronic Systems		
Тур	Practical Course		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		

Workiedd in Hodis	macpendent study nine 40, study nine in Ecclule 14
Lecturer	Prof. Uwe Weltin
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 (L0324)		Recitation Section (small)	1	2		
Module Responsible	Prof. Heiko Falk					
Admission Requirements	None					
Recommended Previous	Basic knowledge in electrical engineering					
Knowledge						
	After taking part successfully, students have	reached the following learning results				
Professional Competence	This module doels with the foundations of t	the functionality of computing suctors . It can	are the laware from	the eccembly le		
Kilowieuge	programming down to gates. The module inc	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-le programming down to gates. The module includes the following topics:				
	Introduction					
	 Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design 					
	 Technological foundations 	systematic hardware design				
	Computer arithmetic: Integer addition,	subtraction, multiplication and division				
		amming models, MIPS single-cycle architecture	e, pipelining			
	Memories: Memory hierarchies, SRAM,	DRAM, caches				
	Input/output: I/O from the perspective	of the CPU, principles of passing data, point-to	-point connections,	busses		
Skills	The students perceive computer systems fro	m the architect's perspective, i.e., they identify	the internal struct	ure and the physi		
		nts can analyze, how highly specific and indivi				
		ney are able to distinguish between and to ex				
	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 interdeper	ndencies between	a physical compu		
		particular, they shall understand the consequer				
		om the assembly language down to gates. Thi				
	the impact that these low abstraction levels h	nave on an entire system's performance and to	propose feasible o	ptions.		
Personal Competence						
	Students are able to solve similar problems a	lone or in a group and to present the results a	cordinaly			
Social competence	students are usie to solve similar problems a	tone of in a group and to present the results at	ccorunigiy.			
Autonomy	Students are able to acquire new knowledge	from specific literature and to associate this kr	nowledge with othe	r classes.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points						
Course achievement	Compulsory Bonus Form	Compulsory Bonus Form Description				
	Yes 10 % Excercises					
	Written exam					
	90 minutes, contents of course and labs					
scale	Conoral Engineering Science (Cormon progra	am, 7 semester): Specialisation Computer Scier	col Compulsory			
		am, 7 semester): Specialisation Computer Scient am, 7 semester): Specialisation Bioprocess Engi		rv		
. choiring carriera		am, 7 semester): Specialisation Naval Architect		. ,		
		am, 7 semester): Specialisation Electrical Engin		/		
	General Engineering Science (German progra	am, 7 semester): Specialisation Biomedical Eng	ineering: Compulso	ry		
	General Engineering Science (German progra	am, 7 semester): Specialisation Energy and Env	viromental Engineer	ring: Compulsory		
	General Engineering Science (German progra	am, 7 semester): Specialisation Process Engine	ering: Compulsory			
	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mechani	cal Engineering, F	ocus Mechatron		
	Compulsory					
		neral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome				
		ngram, 7 semester): Specialisation Mechanic		ocus Biomechani		
	Compulsory	-				
	Compulsory General Engineering Science (German proc	ogram, 7 semester): Specialisation Mechanio gram, 7 semester): Specialisation Mechanica				
	Compulsory General Engineering Science (German prog Engineering: Compulsory	-	l Engineering, Foc	us Aircraft Syste		
	Compulsory General Engineering Science (German prog Engineering: Compulsory	gram, 7 semester): Specialisation Mechanica	l Engineering, Foc	us Aircraft Syste		
	Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German pr Engineering Sciences: Compulsory	gram, 7 semester): Specialisation Mechanica	l Engineering, Foc	us Aircraft Syste Focus Materials		
	Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German pr Engineering Sciences: Compulsory General Engineering Science (German progra Engineering: Compulsory	gram, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechan am, 7 semester): Specialisation Mechanical Eng	I Engineering, Foc nical Engineering, gineering, Focus Th	us Aircraft Syste Focus Materials eoretical Mechani		
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	Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog and Production: Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog	gram, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechan am, 7 semester): Specialisation Mechanical Eng am, 7 semester): Specialisation Mechanical En	I Engineering, Foc nical Engineering, gineering, Focus Th ngineering, Focus P I Engineering, Focu	us Aircraft Syste Focus Materials eoretical Mechani roduct Developm us Energy Syster		
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	Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Computer Science: Core Qualification: Computer Computer Science: Core Qualification: Computer Scienc	gram, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanical En- gram, 7 semester): Specialisation Mechanical Er gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Civil Engineerin ulsory mpulsory	I Engineering, Foc nical Engineering, gineering, Focus Th ngineering, Focus P I Engineering, Focu I Engineering, Focu	us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy Syster		
	Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German prog and Production: Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Computer Science: Core Qualification: Compu Data Science: Core Qualification: Elective Con Electrical Engineering: Core Qualification: Compu	gram, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanical En- gram, 7 semester): Specialisation Mechanical Er gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Mechanical gram, 7 semester): Specialisation Civil Engineerin ulsory mpulsory	I Engineering, Foc nical Engineering, gineering, Focus Th ngineering, Focus P I Engineering, Foc I Engineering, Foc I Engineering, Foc	us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy Syste us Energy Syste		
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G	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
S	Sciences: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
а	and Production: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
0	Computational Science and Engineering: Core Qualification: Compulsory
N	Mechatronics: Core Qualification: Compulsory
Т	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	jineering		
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: Computer Engineering			
Тур	Recitation Section (small)		
Hrs/wk			
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: Integ	rated Product De	velopment and	l Lightweigh	t Design		
Courses						
Title CAE-Team Project (L0271)				Typ Project-/problem-based Learning	Hrs/wk	CP 2
Development of Lightweight Design	Products (L0270)			Lecture	2	2
Integrated Product Development I (L0269)				Lecture	2	2
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous	Advanced Knowledge ab	out engineering desig	in:			
Knowledge	Fundamentals of Mechar	nical Engineering Desi	gn			
	lechanical Engineering: Design					
	Advanced Mechanical En	gineering Design				
Educational Objectives	After taking part success	fully, students have r	eached the followi	ng learning results		
Professional Competence						
Knowledge	After completing the mo	dule, students are ca	bable of:			
	 explaining the fun 	ctional principle of 3D	D-CAD-Systems, PD	M- and FEM-Systems		
				the product development proces	S	
CL 11						
Skills						
	After completing the mo	dule, students are ab	le to:			
	 evaluate different 	CAD- and PDM-Syst	ems with regards	to the desired requirements su	ich as classifi	cation schemes and
	product structurin	-				
	 design an exemple 	ary product using CAI	D-,PDM- and/or FEN	1-Systems with shared workload		
Personal Competence						
Social Competence	After completing the mo	dule, students are ab	le to:			
	 To develop a proje 	ect plan and allocate	work appropriate w	ork packages in the framework	of group discu	issions
	 Present project re 	sults as a team for ins	stance in a present	ation		
Autonomy	Students are capable of:					
	 independently ada 	apt to a CAE-Tool and	complete a given	practical task with it		
Werkleed in Hours	Independent Chudu Time		atura 04			
	Independent Study Time	96, Study Time in Le	cture 84			
Credit points	6 Compulsory Bonus Fe	prm	Description			
Course achievement				ojekt inkl. Vortrag und Ausarbeitu	ing	
		ractical work		, ,	5	
Examination	Written exam					
Examination duration and	90					
scale						
Assignment for the	General Engineering Sc	ience (German prog	ram, 7 semester)	Specialisation Mechanical Eng	ineering, Foc	us Aircraft Systems
Following Curricula	Engineering: Compulsory	/				
	General Engineering Scie	ence (German progra	m, 7 semester): S	pecialisation Mechanical Engine	ering, Focus P	roduct Development
	and Production: Compuls	-				
	Engineering Science: Spe		5 5			
			am, 7 semester):	Specialisation Mechanical Eng	ineering, Foci	us Aircraft Systems
	Engineering: Compulsory		m 7 comostor): Si	acciplication Machanical Engine	pring Eocus P	raduct Davalanment
	and Production: Compuls		, / semester): S	pecialisation Mechanical Enginee	anity, rocus P	iouuci Development
			1 7 semester): Sne	cialisation Mechanical Engineeri	na: Elective Co	ompulsory
				-	ng. Licenve et	shipulsory
	Mechanical Engineering: Specialisation Product Development and Production: Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory					
				plementary Course Core Studies:	Elective Comp	oulsory

Course L0271: CAE-Team Pro	ject				
Тур	Project-/problem-based Learning				
Hrs/wk	2				
СР					
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Dieter Krause				
Language	DE				
Cycle	SoSe				
Content	 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: Development of Lightweight Design Products				
Тур	Lecture			
Hrs/wk				
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Dieter Krause, Prof. Benedikt Kriegesmann			
Language	E			
Cycle	Se			
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. 			

Course L0269: Integrated Product Development I				
Тур	Lecture			
Hrs/wk				
CP	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 			

Module M0767: Aeror	autical Systems				
Courses					
Title		Тур	Hrs/wk	СР	
Fundamentals of Aircraft Systems		Lecture	2	2	
Fundamentals of Aircraft Systems (Recitation Section (small)	1	1	
Air Transportation Systems (L0591) Lecture 2					
Air Transportation Systems (L0816		Recitation Section (large)	1	1	
Module Responsible	Prof. Frank Thielecke				
Admission Requirements	None				
Recommended Previous	Basics of mathematics, mechanics and th	nermodynamics			
Knowledge					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
Professional Competence					
Knowledge	Students get a basic understanding of t	he structure and design of an aircraft, as well a	s an overview of t	he systems inside a	
	aircraft. In addition, a basic knowledge of	f the relationchips, the key parameters, roles and	ways of working in	different subsystem	
	in the air transport is acquired.				
Skills	Due to the learned cross-system thinki	ng students can gain a deeper understanding	of different system	n concepts and the	
	technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystem				
	the air transportation system in the context of the overall system.				
Personal Competence					
Social Competence	Students are made aware of interdisciplir	nary communication in groups.			
Autonomy	Students are able to independently ana	alyze different system concepts and their techn	ical implementation	n as well as to thin	
	system oriented.				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	150 min				
scale					
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mechanic	al Engineering, Fo	cus Aircraft System	
-	Engineering: Compulsory	· · ·		-	
	General Engineering Science (English p	program, 7 semester): Specialisation Mechanic	al Engineering, Fo	cus Aircraft System	
	Engineering: Compulsory	·			
	Logistics and Mobility: Specialisation Logi	istics and Mobility: Elective Compulsory			
	Mechanical Engineering: Specialisation A	ircraft Systems Engineering: Compulsory			

Course L0741: Fundamentals of Aircraft Systems		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. 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: Fundamentals of Aircraft Systems		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	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	

Typ Lecture Hrs/wk 2 CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Vorkload in Hours Prof. Volker Gollnick Language DE Cycle SoSe Content 1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amnufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air transportation 10. Future perspectives of air transport Literature 1. V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 2. H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, ISBN 978-3-7091-1879-5 1. H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 3. K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 4. I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5 5. D. P. Rayme: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 6. M. Hoherder Unitation Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3	Course L0591: Air Transportation Systems			
CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Volker Gollnick Language DE Cycle SoSe Content 1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amnufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air transportation 10. Future perspectives of air transportation 10. Future perspectives of air transport 1. V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 2. H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, ISBN 978-3-7091-1879-5 2. H. Minecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 4. I. Moir, A. Seabridge: "Aircraft Dsystem", AIAA Education Series, 2001, ISBN 1-56347-206-5 5. D.P. Raymer: "Aircraft Dsystem", AIAA Education Series, 2006, ISBN 1-56347-281-3	Тур	Lecture		
Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecture Prof. Volker Gollnick Language DE Cycle SoSe Content 1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air transportation 10. Future perspectives of air transportation 9. Environmental aspects of air transportation 10. Future perspectives of air transport Literature 1. V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 2. Humesne: "Handbuch der Luffahrt", Springer-Verlag, 2003 3. K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 4. I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5 5. D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3	Hrs/wk	2		
Lecturer Prof. Volker Gollnick Language DE Cycle SoSe Content 1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amnufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air transportation 10. Future perspectives of air transport Literature 1. V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 2. H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, ISBN 978-3-7091-1879-5 4. I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2000, ISBN 3-613-01895-0 4. I. Moir, A. Seabridge: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3	CP			
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6 N. Ashford, "Aiment Operational", McCraw IIII, 1007, ICDN0.07,003077.4		5. D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3		
 N. Asntord: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4 		6. N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4		
7. P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8		7. P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8		
8. H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0		8. H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0		

Course L0816: Air Transportation Systems			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Volker Gollnick		
Language	DE		
Cycle	SoSe		
Content	Practical exercises to understand		
	 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		

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.

A						
Courses						
Title		Тур	Hrs/wk	СР		
Advanced Mechanical Engineering Design II (L0264) Lecture 2 2 Advanced Mechanical Engineering Design II (L0264) 2 1				2		
			2			
	chanical Engineering Design I (L0262) Lecture 2 2 1					
Module Responsible						
Admission Requirements						
Recommended Previous						
Knowledge	 Fundamentals of Mechanical Eng 	Jineering Design				
J.	Mechanics					
	Fundamentals of Materials Scient	ce				
	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:				
-						
		les and functions of machine elements and of basic ele				
		criteria, application scenarios and practical examples of	of complex machi	ne elements,		
	 indicate the background of dimensional dimensionadi dimensional dimensionada dimensi dimensionada dimensionada di	nsioning calculations.				
Skills	After passing the module, students are	able to:				
		ations of covered machine elements,	h da a al dila)			
		e module to new requirements and tasks (problem sol	iving skills),			
	 recognize the content of technica evaluate complex designs, technica 	al drawings and schematic sketches,				
	• evaluate complex designs, techn	icany.				
Personal Competence						
Social Competence	. Chudente ere eble te discuss tech	aniant information in the last we supported by activati				
	 Students are able to discuss tech 	nnical information in the lecture supported by activatir	ng methods.			
Autonomy						
		Itly deepen their acquired knowledge in exercises.		here and the second state		
	Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the			. by using the vide		
	recordings of the lectures.					
Workload in Hours	Independent Study Time 68, Study Time	e in Lecture 112				
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	120					
scale		n neartan 7 consister). Createlization Machanical				
	General Engineering Science (Germar	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory		cus Aircraft System		
Assignment for the	General Engineering Science (Germar Engineering: Compulsory	n program, 7 semester): specialisation Mechanical	Engineering, Foo	tus Aircraft System		
Assignment for the	Engineering: Compulsory	an program, 7 semester): Specialisation Mechanical				
Assignment for the	Engineering: Compulsory					
Assignment for the	Engineering: Compulsory General Engineering Science (Germa Engineering Sciences: Compulsory		cal Engineering,	Focus Materials		
Assignment for the	Engineering: Compulsory General Engineering Science (Germa Engineering Sciences: Compulsory General Engineering Science (Germa Compulsory	an program, 7 semester): Specialisation Mechanic an program, 7 semester): Specialisation Mechanica	cal Engineering, al Engineering,	Focus Materials Focus Mechatronic		
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
Compulsory
Mechanical Engineering: Core Qualification: Compulsory
Naval Architecture: Core Qualification: Compulsory

ourse L0264: Advanced Med	chanical Engineering Design II			
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff			
Language	DE			
Cycle	SoSe			
Content	Advanced Mechanical Engineering Design I & II			
	Lecture			
	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:			
	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.			
	Sowie weitere Bücher zu speziellen Themen			

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

Typ	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			
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		
	 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 f ür 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, aktu Auflage. 		
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.		

Course 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		Тур	Hrs/wk	СР
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0433)		Recitation Section (small)	2	2
•	Prof. Gerhard Bauch			
Admission Requirements	None Mathematica 1.2			
Recommended Previous Knowledge	Mathematics 1-3			
Kilowiedge	The modul is an introduction to the theory of signals and	systems. Good knowledge in maths	as covered by the	e moduls Mathema
	1-3 is expected. Further experience with spectral transf	ormations (Fourier series, Fourier tra	ansform, Laplace	transform) is usef
	but not required.			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals ar	nd linear time-invariant (LTI) systems	using methods of	of signal and syste
	theory. They are able to apply the fundamental transfor	mations of continuous-time and disc	rete-time signals	s and systems. The
	can describe and analyse deterministic signals and sys	•	-	
	understand the effects in time domain and image dom	ain which are caused by the transit	tion of a continu	ous-time signal to
- <i></i>	discrete-time signal.			
Skills	The students are able to describe and analyse determini	-		-
	system theory. They can analyse and design basic s response, stability, linearity etc They can assess the im			
Personal Competence	response, stability, intearity etc They can assess the int	succor En systems on the signal pro	percies in cime di	in frequency donia
	The students can jointly solve specific problems.			
	The students are able to acquire relevant informatio	n from appropriate literature sourc	es. They can c	ontrol their level
,	knowledge during the lecture period by solving tutorial p		-	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Electrical Enginee	ering: Compulsor	ý
Following Curricula	General Engineering Science (German program, 7 semes	ter): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Bioprocess Engine	eering: Compulso	ory
	General Engineering Science (German program, 7 semes			-
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering, F	ocus Biomechanic
	Compulsory General Engineering Science (German program, 7 ser	nostor), Enocialization Machanical	Engineering For	us Eporau System
	Compulsory	nester). Specialisation Mechanical	ingineering, roc	us Ellergy System
	General Engineering Science (German program, 7 sei	nester): Specialisation Mechanical	Engineering, Foc	us Aircraft Systen
	Engineering: Compulsory		5	
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	l Engineering, l	Focus Mechatronic
	Compulsory			
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engir	neering, Focus Th	neoretical Mechanic
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semest	er): Specialization Electrical Engineer	ring: Compulsory	
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 semest			ry
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanica	Engineering, F	ocus Biomechanic
	Compulsory			
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical I	Engineering, Foc	us Energy System
	Compulsory			
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical	Engineering, Foc	us Aircraft Systen
	Engineering: Compulsory			teriolo in En 1
	General Engineering Science (English program, 7 semest	er): Specialisation Mechanical Engine	eering, Focus Mat	teriais in Engineerir
	Sciences: Compulsory	mostor), Specialization Machanist		Focus Mochatrasia
	General Engineering Science (English program, 7 so Compulsory	encester). Specialisation Mechanica	i Engineering, I	ocus Mechatronic
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engin	eerina. Focus Th	eoretical Mechanic
	Engineering: Compulsory			
	Computational Science and Engineering: Core Qualificati	on: Compulsory		
	,	· · · · · · · · · · · · · · · · · · ·		
	Mechatronics: Core Qualification: Compulsory			

Course L0432: Signals and Systems			
Тур	Lecture		
Hrs/wk	3		
СР	4		
-	of. 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 and S	Course 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	

ourses				
itle		Түр	Hrs/wk	СР
Fundamentals of Mechanical Prope	ties of Materials (L1090)	Lecture	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science			
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowleg in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dynam loads. The students get to know the most important welding technologies and the corresponding systems. They learn about t influence of welding on the materials and design.			
Skills	Its students know the mechanical properties of metals and the underlying principles. They are able to name the influence 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 able to dimension weld joints within design tasks.			
Personal Competence				
Social Competence	none			
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation M	lechanical Engineering,	Focus Materials
Following Curricula	Engineering Sciences: Compulsory General Engineering Science (English prog Sciences: Compulsory Mechanical Engineering: Specialisation Ma	ram, 7 semester): Specialisation Mechanica		erials in Engineer

Typ Lecture Hrs/wk 2 CP 3	
CP 3	
Workload in Hours Independent Study Time 62, Study Time in Lecture 28	
Lecturer Prof. Norbert Huber	
Language DE	
Cycle SoSe	
Content 1. Introduction and overview	
2. Bonding and crystallography, stress, strain, linear elasticity	
3. Plasticity of metallic materials	
4. Dislocations: Structure, stress, strain, strain energy	
5. Dislocations: Motion and forces	
6. Partial dislocations, dislocation interactions, jogs and kinks	
7. Strengthening mechanisms	
8. Introduction to modelling of materials behaviour, classification of	
phenomena	
9. Linear and nonlinear elasticity	
10. Plasticity, tensile loading, cyclic loading	
11. Viscoelasticity, effects of loading history, creep, relaxation	
12. Viscoplasticity, overstress, rate sensitivity of metallic materials	
13. Identification of material parameters	
Literature Hull and Bacon: Introduction to Dislocations (1984)	
G. Gottstein: Physik. Grundlagen der Materialk. (2001)	
o. ootacini i nysik. oranalagen dei natentaik. (2001)	
N.Huber: Scriptum "Materialtheorie" Uni Karlsruhe (1998)	
P. Haupt: Cont. Mechanics and Theory of Materials (2002)	

Course L1123: Welding Tech	nology
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer
Language	DE
Cycle	WiSe
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
	- deposition welding
	- electron beam welding/ laser beam welding
	- weld joint designs and declarations
	- computation methods for weld joint dimensioning
Literature	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

	rical Mathematics I
Courses	
Title	Typ Hrs/wk CP
Numerical Mathematics I (L0417)	Lecture 2 3
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3
Module Responsible	Prof. Sabine Le Borne
Admission Requirements	None
Recommended Previous	
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematici basic MATLAB knowledge
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to
	name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root find
	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.
Skills	Students are able to
	 implement, apply and compare numerical methods using MATLAB,
	 justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm,
	 select and execute a suitable solution approach for a given problem.
Personal Competence	
Social Competence	Students are able to
	 work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge and bit the particulation of all states and a state and the particulation of the particulation of all states and the particulation of the particulation o
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms
Autonomy	Students are capable
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
	 to assess their individual progess and, if necessary, to ask questions and seek help.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
Examination	
	90 minutes
scale	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials
	Engineering Sciences: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Compulsory
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory
	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory
	Data Science: Core Qualification: Compulsory
	Electrical Engineering: Core Qualification: Elective Compulsory
	Engineering Science: Core Qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Core Qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory Concrete Engineering Science (English program, 7 competer): Specialization Mechanical Engineering, Engus Materials in Engineering
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer
	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory
	I neoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Course L0417: Numerical Ma	thematics I
Тур	Lecture
Hrs/wk	2
CP	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
CP	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 M1009: Mate	rial Science Laboratory			
Courses				
Fitle		Тур	Hrs/wk	СР
Companion Lecture for Materials So	cience Laboratory (L1088)	Lecture	2	2
Material Science Laboratory (L1235	5)	Practical Course	4	4
Module Responsible	Prof. Kaline Pagnan Furlan			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary	of the technical details of experiments in th	e area of materials so	iences and illustra
-	respective relationships. They are capa	able of describing and communicating relevan	problems and questic	ns using appropria
		ne typical process of solving practical problems		
Skills	Skills The students can transfer their fundamental knowledge on material sciences to the process of solving practical		tical problems. Th	
	identify and overcome typical problems	during the realization of experiments in the co	ntext of material science	es.
Personal Competence				
-	Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are at			
,		results alone or in groups in front of a qualified		,
Autonomy		ns in the context of materials sciences using p		y are able to fill ga
	in as well as extent their knowledge using	ng the literature and other sources provided by	the supervisor.	
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	1,5 h written Exam (50%) covering the I	lesson		
scale				
Assignment for the	General Engineering Science (Germa	an program, 7 semester): Specialisation Me	chanical Engineering,	Focus Materials
Following Curricula	Engineering Sciences: Compulsory			
	General Engineering Science (English p	rogram, 7 semester): Specialisation Mechanical	Engineering, Focus Ma	terials in Engineeri
	Sciences: Compulsory			
	Mechanical Engineering: Specialisation	Product Development and Production: Compuls	ory	
	Mechanical Engineering: Specialisation	Materials in Engineering Sciences: Compulsory		
	Product Development, Materials and Pro	oduction: Technical Complementary Course Cor	e Studies: Elective Com	inulsory

Course L1088: Companion Lecture for Materials Science Laboratory		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Patrick Huber	
Language	DE	
Cycle	WiSe	
Content	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
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Bodo Fiedler, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II

rp cture (citation Section (small) earning results nputing systems. It covers ics: ns, hardware synthesis, co esign tion and division single-cycle architecture, p of passing data, point-to-pr ective, i.e., they identify th ighly specific and individu uish between and to expla- e processors. to judge the interdepended iderstand the consequence uage down to gates. This w m's performance and to p to present the results accor- and to associate this know	mbinational network opelining oint connections, he internal struct al computers car in the different a encies between a es that the execu- vay, they will be ropose feasible o rdingly.	vorks busses ure and the phys a be built based of abstraction layer a physical compu- ution of software enabled to evalu- ptions.
cture citation Section (small) earning results nputing systems. It covers ics: ns, hardware synthesis, co esign tion and division single-cycle architecture, p of passing data, point-to-po ective, i.e., they identify th ighly specific and individu uish between and to explate processors. to judge the interdepended iderstand the consequence uage down to gates. This w m's performance and to p to present the results account	3 1	4 2
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nputing systems. It covers ics: ns, hardware synthesis, co esign ation and division single-cycle architecture, p of passing data, point-to-po ective, i.e., they identify th highly specific and individu uish between and to expla- e processors. to judge the interdependen- iderstand the consequence uage down to gates. This w m's performance and to p to present the results acco	mbinational network opelining oint connections, he internal struct al computers car in the different a encies between a es that the execu- vay, they will be ropose feasible o rdingly.	vorks busses ure and the phys a be built based of abstraction layer a physical compu- ution of software enabled to evalu- ptions.
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esign ation and division single-cycle architecture, p of passing data, point-to-po- ective, i.e., they identify th highly specific and individu uish between and to expla- e processors. to judge the interdependu- iderstand the consequence uage down to gates. This w m's performance and to p to present the results acco	pipelining bint connections, ne internal struct al computers car in the different is encies between is es that the execu- vay, they will be ropose feasible o rdingly.	busses ure and the phys a be built based of abstraction layer a physical compu- ution of software enabled to evalu ptions.
		r classes.
		r classes.
alisation Computer Science	: Compulsory	
ialisation Mechanical Engi	ring: Compulsory eering: Compulsory mental Engineer ng: Compulsory Engineering, F Engineering, Foc al Engineering, Foc al Engineering, eering, Focus Th heering, Focus P	ry ing: Compulsory focus Mechatron ocus Biomechan us Aircraft Syste Focus Materials eoretical Mechan roduct Developm
	ngineering, Foci	
	ialisation Mechanical Engir ecialisation Mechanical E ecialisation Mechanical E	alisation Mechanical Engineering, Focus Th ialisation Mechanical Engineering, Focus P ecialisation Mechanical Engineering, Focu ecialisation Mechanical Engineering, Focu

G	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
S	Sciences: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
а	and Production: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
0	Computational Science and Engineering: Core Qualification: Compulsory
N	Mechatronics: Core Qualification: Compulsory
Т	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	jineering
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 Eng	Course L0324: Computer Engineering		
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses						
Title		Тур	Hrs/wk	СР		
Enhanced Fundamentals: Ceramics	and Polymers (L1233)	Lecture	2	2		
Enhanced Fundamentals: Ceramics	-	Recitation Section (large)	1	1		
Enhanced Fundamentals: Metals (L	1086)	Lecture	2	3		
Module Responsible	Prof. Gerold Schneider					
Admission Requirements	None					
Recommended Previous	Module "Fundamentals of Materials Science	e"				
Knowledge	Module "Materials Science Laboratory"					
	Module "Advanced Materials"					
Educational Objectives	After taking part successfully, students have	ve reached the following learning results				
Professional Competence						
Knowledge	The students are able to give an enhanced	overview over the following topics				
	in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects , electrical and mass transpo					
Skills		are capable to explain the corresponding technioning technioning technioning technioning technioning technical methods for the abc		jects.		
Personal Competence Social Competence Autonomy						
Workload in Hours	Independent Study Time 110, Study Time i	in Lecture 70				
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	180 min					
scale						
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mecha	nical Engineering	, Focus Materials		
Following Curricula	Engineering Sciences: Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmer					
	and Production: Compulsory					
	Data Science: Core Qualification: Elective C	Compulsory				
	General Engineering Science (English prog	ram, 7 semester): Specialisation Mechanical Eng	gineering, Focus Ma	aterials in Engineeri		
	Sciences: Compulsory					
		gram, 7 semester): Specialisation Mechanical E	ngineering, Focus	Product Developme		
	and Production: Compulsory					
		terials in Engineering Sciences: Compulsory				

Course L1233: Enhanced Fur	ndamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	
Cycle	
Content	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)
	4. Sintern
	Triebkraft des Sinterns
	Effekt von gekrümmten Oberflächen und Diffusionswegen
	Sinterstadien des isothermen Festphasensinterns
	Herring scaling laws Heißisostatisches Pressen
	5. Mechanische Eigenschaften von Keramiken
	Elastisches und plastisches Materialverhalten
	Bruchzähigkeit - Linear-elastische Bruchmechanik
	Festigkeit - Festigkeitsstreuung
	6. Elektrische Eigenschaften von Keramiken
	Ferroelektische Keramiken
	Piezo-, ferroelektrische Materialeigenschaften
	Anwendungen
	Keramische Ionenleiter
	Ionische Leitfähigkeit
	Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde
Literature	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
	Polymerwerkstoffe
	Struktur und mechanische Eigenschaften G.W.Ehrenstein;
	Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	Kunststoffphysik
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €
	Werkstoffkunde Kunststoffe G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €
	Kunststoff-Kompendium
	A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

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

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

Focus Mechatronics

	nced M	Mechanical	Engineering Des	sign			
Courses							
Title					Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II	(L0264)			Lecture	2	2
Advanced Mechanical Engineering	-				Recitation Section (large)	2	1
Advanced Mechanical Engineering	Design I ((L0262)			Lecture	2	2
Advanced Mechanical Engineering	Design I ((L0263)			Recitation Section (large)	2	1
Module Responsible	Prof. Di	ieter Krause					
Admission Requirements	None						
Recommended Previous		5	Markenia I Fasia ania	Design			
Knowledge		Mechanics	Mechanical Engineering	Design			
			Materials Science				
		Production Engin					
	• 1	Toddectorr Erigin	cering				
Educational Objectives	After ta	aking part succes	sfully, students have rea	ached the followir	g learning results		
Professional Competence							
Knowledge	After pa	assing the modu	le, students are able to:				
	•	ovolain comploy	working principlos and f	inctions of machi	ne elements and of basic	olomonts of fluidics	
					ios and practical example		
			cground of dimensioning	••	ios and practical example	s of complex mach	ine elements,
	- 1	indicate the baci	ground of dimensioning	culculations.			
Skills	After pa	assing the modu	le, students are able to:				
	• 3	accomplish dime	ensioning calculations of	covered machine	elements		
					ients and tasks (problem s	solving skills)	
			ntent of technical drawin			Solving Skins),	
			x designs, technically.	go and serieman	Sketches,		
		ardidate comple	k debiglib, teenniedilyr				
Personal Competence							
Social Competence		Students are abl	o to discuss tochnical inf	ormation in the le	cture supported by activa	ting mothods	
	• 3	students are apr				ting methods.	
Autonomy		Churcheneter and a hel	- to independently deep				
			e to independently deep			anatood contont of	hu uning the uid
		recordings of the		knowledge and to	p recapitulate poorly unde	erstood content e.g	g. by using the via
	T I	ecordings of the	lectures.				
Workload in Hours	Indeper	ndent Study Tim	e 68, Study Time in Lect	ure 112			
Credit points	6						
Course achievement	None						
Examination	Written	ı exam					
	120						
Examination duration and							
Examination duration and scale							
scale Assignment for the				m, 7 semester):	Specialisation Mechanica	al Engineering, Fo	cus Aircraft Syste
scale Assignment for the	Enginee	ering: Compulso	ry				
scale Assignment for the	Enginee General	ering: Compulso	ry Science (German prog		Specialisation Mechanica		
scale Assignment for the	Enginee General Enginee	ering: Compulso al Engineering s ering Sciences: (ry Science (German prog Compulsory	am, 7 semeste	r): Specialisation Mecha	nical Engineering,	Focus Materials
scale Assignment for the	Enginee General Enginee General	ering: Compulso al Engineering ering Sciences: (al Engineering S	ry Science (German prog Compulsory	am, 7 semeste		nical Engineering,	Focus Materials
scale Assignment for the	Enginee General Enginee General Compul	ering: Compulso al Engineering ering Sciences: (al Engineering S ilsory	ry Science (German prog Compulsory Science (German progr	ram, 7 semeste am, 7 semester	r): Specialisation Mecha	nical Engineering, ical Engineering,	Focus Materials Focus Mechatroni
scale Assignment for the	Enginee General Enginee General Compul General	ering: Compulso al Engineering s ering Sciences: (al Engineering s al Engineering Sci	ry Science (German progr Compulsory Science (German progr cience (German program	ram, 7 semeste am, 7 semester	r): Specialisation Mecha	nical Engineering, ical Engineering,	Focus Materials Focus Mechatroni
scale Assignment for the	Enginee General Enginee General Compul General and Pro	ering: Compulso al Engineering : ering Sciences: C al Engineering S Ilsory al Engineering Sc oduction: Compu	ry Science (German progr Compulsory Science (German progr cience (German program Ilsory	ram, 7 semeste am, 7 semester , 7 semester): Sp	r): Specialisation Mecha): Specialisation Mechan Pecialisation Mechanical E	nical Engineering, ical Engineering, ngineering, Focus I	Focus Materials Focus Mechatroni Product Developme
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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

Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
	Prof. Dieter Krause, Prof. Otto von Estorff			
Language				
Cycle				
	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			
	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-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, aktu			
	Auflage.			
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.			
	Sowie weitere Bücher zu speziellen Themen			

Course L0265: Advanced Me	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		

Hrs/wk 2 CP 2 Workload in Hours 1 Lecturer 6 Language 1 Cycle 1 Content 6				
Hrs/wk 2 CP 2 Workload in Hours 1 Lecturer 4 Language 1 Cycle 1 Content 4	2 Independent Study Time 32, Study Time in Lecture 28 Prof. Dieter Krause, Prof. Otto von Estorff DE WiSe Advanced Mechanical Engineering Design I & II			
CP 2 Workload in Hours 1 Lecturer 6 Language 1 Cycle 1 Content 6	Independent Study Time 32, Study Time in Lecture 28 Prof. Dieter Krause, Prof. Otto von Estorff DE WiSe Advanced Mechanical Engineering Design I & II			
Lecturer f Language [Cycle \ Content /	Prof. Dieter Krause, Prof. Otto von Estorff DE WiSe Advanced Mechanical Engineering Design I & II			
Lecturer f Language [Cycle \ Content /	Prof. Dieter Krause, Prof. Otto von Estorff DE WiSe Advanced Mechanical Engineering Design I & II			
Language [Cycle \ Content /	DE WiSe Advanced Mechanical Engineering Design I & II			
Cycle \ Content	WiSe Advanced Mechanical Engineering Design I & II			
Content	Advanced Mechanical Engineering Design I & II			
1	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			
1	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-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. Masshinganglemente 1.2: Schlacht, B., Bearcen Verlag, aktuelle Auflage.			
	 Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung Berechnung Anwendung: Haberhauer, H. Bodenstein, F. Springer-Verlag, aktuelle 			
	 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.			
5	Sowie weitere Bücher zu speziellen Themen			

Course L0263: Advanced Me	Course 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					
Courses					
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4	
Signals and Systems (L0432)		Recitation Section (small)	2	2	
	Prof. Gerhard Bauch				
Admission Requirements	None				
-	Mathematics 1-3				
Knowledge					
-	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Math				
	1-3 is expected. Further experience with spectral tra	nsformations (Fourier series, Fourier tr	ansform, Laplace	transform) is use	
	but not required.				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	The students are able to classify and describe signals	and linear time-invariant (LTI) systems	s using methods (of signal and syste	
	theory. They are able to apply the fundamental trans	formations of continuous-time and dis	crete-time signals	s and systems. Th	
	can describe and analyse deterministic signals and s	systems mathematically in both time a	nd image domai	n. In particular, th	
	understand the effects in time domain and image d	omain which are caused by the transi	tion of a continu	ious-time signal to	
	discrete-time signal.				
Skills	The students are able to describe and analyse determ	ninistic signals and linear time-invariant	systems using m	nethods of signal a	
	system theory. They can analyse and design basic	systems regarding important proper	ties such as ma	agnitude and pha	
	response, stability, linearity etc They can assess the	impact of LTI systems on the signal pro	perties in time ar	nd frequency doma	
Personal Competence					
	The students can jointly solve specific problems.				
Autonomy	The students are able to acquire relevant informa-			ontrol their level	
	knowledge during the lecture period by solving tutoria	al problems, software tools, clicker syste	em.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German program, 7 sen	nester): Specialisation Electrical Engine	ering: Compulsory	У	
Following Curricula	General Engineering Science (German program, 7 sen	nester): Specialisation Computer Scienc	e: Compulsory		
	General Engineering Science (German program, 7 sen	nester): Specialisation Process Engineer	ing: Compulsory		
	General Engineering Science (German program, 7 sen				
	General Engineering Science (German program, 7 sen				
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineering, F	ocus Biomechani	
	Compulsory		F acility F ac	E	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Foc	us Energy Systen	
	Compulsory	compostor), Englishing Machanical	Engineering For	aug Aircraft System	
	General Engineering Science (German program, 7 Engineering: Compulsory	semester): specialisation Mechanical	Engineering, Foc	LUS AITCIAIL SYSLEI	
	General Engineering Science (German program,	7 comostor): Specialisation Mechanic		Focus Matorials	
	Engineering Sciences: Compulsory	/ semester). Specialisation Mechanic	ai Liigineeniig,	Tocus Materials	
	General Engineering Science (German program, 7	semester): Specialisation Mechanics	al Engineering '	Focus Mechatroni	
	Compulsory	semester). Specialisation Mechanica	ii Liigineeniig, i	rocus mechatroni	
	General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical Engli	neering Focus Th	eoretical Mechani	
	Engineering: Compulsory		leening, rocus m		
	Computer Science: Core Qualification: Compulsory				
	Electrical Engineering: Core Qualification: Compulsory				
	General Engineering Science (English program, 7 sem		ring: Compulsory	,	
	General Engineering Science (English program, 7 sem	ester): Specialisation Computer Science	: Compulsory		
	General Engineering Science (English program, 7 sem	ester): Specialisation Process Engineeri	ng: Compulsory		
	General Engineering Science (English program, 7 sem	ester): Specialisation Bioprocess Engine	ering: Compulsor	ry	
	General Engineering Science (English program, 7 sem	ester): Specialisation Biomedical Engine	ering: Compulso	ry	
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani	
	Compulsory				
	General Engineering Science (English program, 7	semester): Specialisation Mechanical	Engineering, Foc	us Energy System	
	Compulsory				
	General Engineering Science (English program, 7	semester): Specialisation Mechanical	Engineering, Foc	cus Aircraft Syste	
	Engineering: Compulsory				
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engin	eering, Focus Mat	terials in Engineeri	
	Sciences: Compulsory				
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering, I	Focus Mechatroni	
	Compulsory				
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanical Engi	eering, Focus Th	neoretical Mechani	
	Engineering: Compulsory				
	Computational Science and Engineering: Core Qualific Mechatronics: Core Qualification: Compulsory	ation: Compulsory			

Course L0432: Signals and Systems	
Тур	Lecture
Hrs/wk	3
СР	4
-	
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 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		Тур	Hrs/wk	СР	
Simulation and Design of Mechatronic Systems (L1822)		Lecture	2	2	
Simulation and Design of Mechatronic Systems (L1823)		Recitation Section (large)	1	2	
Simulation and Design of Mechatro	nic Systems (L1824)	Practical Course	1	2	
Module Responsible	Prof. Uwe Weltin				
Admission Requirements	None				
Recommended Previous	Fundatmentals of mechanics, control theory and	electrical engineering			
Knowledge					
Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence					
Knowledge	Students are able to describe methods and calcu	ulations for design, modeling, simulation and	l optimization of r	nechatronic system	
SKIIIS	Students are able to apply modern algorithms for		an identify, simula	ate and design sim	
	systems and implement those in laboratory conc	litions.			
Personal Competence					
Social Competence	Students are able to work goal-oriented in small mixed groups and present results to target groups.				
4					
Autonomy	Students are able to recognize and improve knowledge deficits independently.				
	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanic	al Engineering,	Focus Mechatroni	
Following Curricula	Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System				
	Engineering: Compulsory				
	Digital Mechanical Engineering: Core Qualification: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft System				
	Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronice				
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic				
	Engineering: Elective Compulsory				
	Mechanical Engineering: Specialisation Aircraft S				
	Mechanical Engineering: Specialisation Mechatro				
	Mechanical Engineering: Specialisation Theoretic				
	Mechanical Engineering: Specialisation Theoretic	ai Mechanical Engineering: Elective Compu	SOLA		

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

Course L1823: Simulation an	urse L1823: Simulation and Design of Mechatronic Systems			
Тур	Recitation Section (large)			
Hrs/wk	1			
CP	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Uwe Weltin			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			
Course L1824: Simulation an	nd Design of Mechatronic Systems			
Тур	Practical Course			
Hrs/wk	1			
CP	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			

Lecturer	Prof. Uwe Weltin
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible	Prof. Alexander Kölpin			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for calcula networks driven by periodic signals. They know the metho domain, and they are able to explain the frequency behavio	ods for transient analysis of linea	ar networks in tir	ne and in frequen
Skills	The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-termin circuits.			
Personal Competence				
Social Competence	Students work on exercise tasks in small guided groups.	They are encouraged to present	and discuss the	ir results within t
Autonomy	group. The students are able to find out the required methods for sknowledge during the lectures continuously by means of educational objectives. They can link their gained knowledge	f short-time tests. This allows	them to control	independently the
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanica	al Engineering, I	ocus Mechatronio
Following Curricula				
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engine	ering: Compulsory	/
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester)	Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanica	I Engineering, I	ocus Mechatronio
	Compulsory			
	Computational Science and Engineering: Specialisation II. M	athematics & Engineering Science	e: Elective Compu	llsory
	Computational Science and Engineering: Specialisation Engi	neering Sciences: Elective Compu	llsory	
	Mechatronics: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

Course L0566: Circuit Theory	
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Arne Jacob, Dr. Fabian Lurz
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 Theory	/
Тур	Recitation Section (small)
Hrs/wk	2
CP	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
Literature	siehe korrespondierende Lehrveranstaltung
	see interlocking course

lown to gates. The module tion titional logic: Gates, Boolear ial logic: Flip-flops, automat ogical foundations er arithmetic: Integer additi f computer architecture: Pr es: Memory hierarchies, SRA tput: I/O from the perspecti erceive computer systems computer systems. The stu w and simple components. ting systems - from gates a al completion of the modul e software executed on it. I re-centric abstraction layer:	ave reached the following of the functionality includes the following and algebra, Boolean fita, systematic hardion, subtraction, murogramming models AM, DRAM, caches ive of the CPU, prime from the architect's udents can analyze, and circuits up to coole, the students are line particular, they sits from the assemblement of the assemblement of the students are line particular, they sits from the assemblement of the students are line particular, they sits from the assemblement of the	of computing systems. It cover ing topics: functions, hardware synthesis, of ware design ultiplication and division s, MIPS single-cycle architecture inciples of passing data, point-to- s perspective, i.e., they identify , how highly specific and indivice distinguish between and to exp implete processors. e able to judge the interdepent shall understand the consequent ly language down to gates. This	combinational net , pipelining point connections, the internal struct Jual computers ca plain the different dencies between ces that the exect	works , busses ture and the phys n be built based of abstraction layer a physical compu
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		e system's performance and to		
ble to solve similar problem	ns alone or in a grou	up and to present the results ac	cordingly.	
ble to acquire new knowled	ge from specific lite	erature and to associate this kn	owledge with othe	r classes.
udy Time 124, Study Time	in Lecture 56			
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us Form % Excercises	Description	1		
ntents of course and labs				
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G	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
S	Sciences: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
C	Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
а	and Production: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
0	Computational Science and Engineering: Core Qualification: Compulsory
N	Mechatronics: Core Qualification: Compulsory
Т	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	jineering
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 Eng	purse L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title		Тур	Hrs/wk	СР	
Semiconductor Circuit Design (L076	3)	Lecture	3	4	
Semiconductor Circuit Design (L086	54)	Recitation Section (small)	1	2	
Module Responsible	Prof. Matthias Kuhl				
Admission Requirements	None				
Recommended Previous	Fundamentals of electrical engineering				
Knowledge	Basics of physics, especially semiconductor p	hysics			
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence Knowledge Skills	 Students are able to explain how analoc Students are able to explain the function Students know the fundamental digital Students have knowledge about memory Students know the appropriate fields for 		l. nd their specificatio s and disadvantage: nd specifications.	5.	
	 Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits Students are able to develop different logic circuits and can design different types of logic circuits. Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications. 				
Personal Competence Social Competence					
Autonomy	• Students are able to assess their level	of knowledge.			
Workload in Hours	Independent Study Time 124, Study Time in I	Lecture 56			
Credit points					
Course achievement					
Examination					
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Electrical Engine	ering: Compulsory		
-		ogram, 7 semester): Specialisation Mechanic			
	Compulsory				
	Data Science: Core Qualification: Elective Cor	mpulsory			
	Electrical Engineering: Core Qualification: Cor	mpulsory			
	Engineering Science: Specialisation Electrical	Engineering: Compulsory			
	Engineering Science: Specialisation Mechatronics: Compulsory				
		m, 7 semester): Specialisation Electrical Engine			
		gram, 7 semester): Specialisation Mechanic	al Engineering, Fo	ocus Mechatron	
	Compulsory	n 7 competer), Crasiclication Machatrasian C	mouleer		
	5 5 5 7 5	n, 7 semester): Specialisation Mechatronics: Co	1	507/	
	Computational Science and Engineering: Specialisation Mechanical Engineering: Specialisation Mecha	cialisation II. Mathematics & Engineering Science atronics: Compulsory	.e. Elective Compul	SULÄ	
	Mechatronics: Core Qualification: Compulsory				
	Technomathematics: Specialisation III. Engine				

Course L0763: Semiconducto	or Circuit Design
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	SoSe
Content	 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

Course L0864: Semiconducto	or Circuit Design
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl, 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 M0854: Mathe	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	 Students can name the basic concepts in Mat 	nematics IV. They are able to explain the	m using appropr	iate examples.
	Students can discuss logical connections between the second			
	the help of examples.		or mascracing c	
	 They know proof strategies and can reproduce 	them		
	• They know proof strategies and carrieproduct	e trieffi.		
Skills	 Students can model problems in Mathematic 	s IV with the help of the concepts studi	ed in this course	. Moreover, they are
	capable of solving them by applying establish			,
	 Students are able to discover and verify further 		nts studied in th	e course
	 For a given problem, the students can deve 	-		
	results.	iop and execute a suitable approach, a		includity evaluate th
	icsuits.			
Personal Competence				
Social Competence	 Students are able to work together in teams. 	They are capable to use mathematics as	a common langu	1200
	 Students are able to work together in teams. 			
	 In doing so, they can communicate new conc decise succession to the shared decise with some decises. 		perating partners	5. Moreover, they ca
	design examples to check and deepen the un	derstanding of their peers.		
Autonomy	 Students are capable of checking their under 	standing of complex concepts on their o	wn They can sr	ecify open question
	precisely and know where to get help in solvin		with they can sp	beeny open question
	 Students have developed sufficient persister 	-	in a goal orior	tod mannor on har
		ice to be able to work for longer period	is in a goal-onei	
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 1	12		
		.12		
Credit points				
Course achievement				
Examination	Written exam 60 min (Complex Functions) + 60 min (Differential E	quations 2)		
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Electrical Engine	erina: Compulso	V
Following Curricula	General Engineering Science (German program, 7 se			
. onowing curriculd	Compulsory	, semestery, specialisation mechanica	Engineering,	. seas meenarionits
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	Engineering: Elective Compulsory	smester, specialisation Mechanical Engli	icening, rocus r	
		the method . Electrical Commuter me		
	Computer Science: Specialisation Computational Ma			
	Computer Science: Specialisation II. Mathematics an		огу	
	Electrical Engineering: Core Qualification: Compulso			
	Engineering Science: Specialisation Electrical Engine			
	General Engineering Science (English program, 7 sei			
	General Engineering Science (English program, 7 sei			
	General Engineering Science (English program,	7 semester): Specialisation Mechanica	l Engineering,	Focus Mechatronics
	Compulsory			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical Engir	neering, Focus T	heoretical Mechanica
	Engineering: Compulsory			
	General Engineering Science (English program, 7 sei	mester): Specialisation Naval Architecture	e: Compulsory	
	Computational Science and Engineering: Specialisati			ulsory
	Mechanical Engineering: Specialisation Mechatronics		1	-
	Mechanical Engineering: Specialisation Theoretical N		ory	
	Mechanical Engineering: Specialisation Theoretical N		-	
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
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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: 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

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

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

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

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

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.

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Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

Typ Lecture Hrs/wk 2 Workload In Hous: Independent Study Time 32, Study Time in Lecture 28 Language DE Language DE Cycte SoSe Context Advanced Mechanical Engineering Design I & II Lecture Fundamentals of the following machine elements: Fundamentals of the following machine elements: Inter rolling bearings Aves 5 shafts Gear drives Elements of fluidics Exercise Cank drives Gear drives Elements of fluidics Exercise Calculation methods of the following machine elements: Inter rolling bearings Aves 5 shafts Calculation methods of the following machine elements: Inter rolling bearings Aves 5 shafts Calculation methods of the following machine elements: Inter rolling bearings Aves 5 shafts Calculation of hydrostatic systems (fluidics) Literature Calculations of hydrostatic systems (fluidics) Kassthinenelemente: 12: Scintek, Seiner, N., Springer-Verlag, Attuelle Auflage. Haschineneumenent: 12: Scinter, N., Bordenstev, N., Bordenstein, F.,	Course L0264: Advanced Me	chanical Engineering Design II
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 Belt & chain drives Gear 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. 		Axes & shafts
 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. 		Clutches & brakes
 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. 		• Belt & chain drives
 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. 		Gear 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. 		• Epicyclic gears
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.		-
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.		
 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. 		Calculations of hydrostatic systems (fluidics)
 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. 	Literature	 Dubbal Tarchaphuch für den Marchingebau, Grote K. H. Foldburge J. (Hrsg.): 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. 		
 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. 		
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Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.		
Auflage.		
Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.		
		Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
Sowie weitere Bücher zu speziellen Themen		Sowie weitere Bücher zu speziellen Themen

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

Typ	Lecture
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	
Cycle	
	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	 Belt & chain drives
	Gear drives
	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-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 - 2, Schecht, B., Feitson Verlag, accele Kanage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktu
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course 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		Тур	Hrs/wk	СР
Production Engineering I (L0608)		Lecture	2	2
Production Engineering I (L0612)		Recitation Section (large)	1	1
Production Engineering II (L0610)		Lecture	2	2
Production Engineering II (L0611)		Recitation Section (large)	1	1
Module Responsible				
-	None			
	no course assessments required			
Knowledge	internship recommended			
	After taking part successfully, students h	nave reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
	name basic criteria for the selection	on of manufacturing processes		
	 name the main groups of Manufac 			
	 name the application areas of diffe 			
		d disadvantages of the different manufacturing proc	cess.	
		perties and kinematic variables and requirements for		and process.
	 explain the essential models of ma 			
Skills	Students are able to			
	 select manufacturing processes in 			
	 design manufacturing processes for 	or simple tasks to meet the required tolerances of t	he component to I	pe produced.
	 assess components in terms of the 	eir production-oriented construction.		
Demonstration of the second second				
Personal Competence	Chudanta and able to			
Social Competence	Students are able to			
	develop solutions in a production	environment with qualified personnel at technical le	evel and represent	decisions.
Autonomy	Students are able to			
Autonomy	Students are able to			
	 interpret independently the manual 	facturing process.		
	 assess own strengths and weakned 	esses in general.		
	 assess their learning progress and 			
	 assess possible consequences of t 	their actions.		
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanical Eng	gineering, Focus Th	neoretical Mechanic
Following Curricula	Engineering: Elective Compulsory			
	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanical Er	igineering, Focus I	Product Developme
	and Production: Compulsory			
	General Engineering Science (English pr	ogram, 7 semester): Specialisation Mechanical Eng	jineering, Focus Tł	neoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (English pr	rogram, 7 semester): Specialisation Mechanical En	gineering, Focus F	Product Developme
	and Production: Compulsory			
	Logistics and Mobility: Specialisation Eng	jineering Science: Elective Compulsory		
	Mechanical Engineering: Core Qualification	on: Compulsory		
	Mechatronics: Core Qualification: Compu			

Course L0608: Production En	igineering I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	 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: Production En	urse L0612: Production Engineering I	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0610: Production En	Course L0610: Production Engineering II		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann		
Language	DE		
Cycle	SoSe		
Content	 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		

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

Courses	
Title	Tun Undult CD
Advanced Mechanical Design Proje	ct (L0266) Typ Hrs/wk CP roject-/problem-based Learning 4 6
Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	Mechanical Engineering: Design
······································	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
-	After passing the module, students are able to:
	a success the success during four succession that the hear allow of
	express the procedure for systematically handling of
	 complex design tasks , describe working principles, their use and combination pessibilities.
	 describe working principles, their use and combination possibilities, explain guidelines for designing for function and manufacturing,
	 explain guidelines for designing for function and manufacturing, explain advanced use-oriented knowledge 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.
Devecuel Commetence	
Personal Competence	After passing the module, students are able to:
Social Competence	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	After passing the module, students are able to:
Autonomy	
	• independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select
	appropriate methods,
	 to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	Compulsory Bonus Form Description
	Yes None Attestation
Examination	Written exam
Examination duration and	180
scale	
5	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
Following Curricula	Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechar
	Engineering: Compulsory
	Mechanical Engineering: Core Qualification: Compulsory

Course L0266: Advanced Med	chanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
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.

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Machine Tools (LO		Lecture	2 1	2
Fundamentals of Machine Tools (L1992) Forming and Cutting Technology (L0613)		Recitation Section (large) Lecture	2	2
Forming and Cutting Technology (L		Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous	without major course assessment			
Knowledge	internation recommended			
	internship recommended			
	Previous knowledge in mathematics, mechanics an	d electrical engineering		
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
-	Students are able to			
	explain the basics of chip formation and med			
	explain methods and parameters for design			
	 explain technical concepts of machine tool b explain types, constructions and functions of 			-
	 explain types, constructions and functions of explain equipment components. 	CNC-machines and give an overview on r	nuiti-machine sys	lems.
	• explain equipment components.			
Skills	Students are able to			
	 select tool geometry, cutting materials, pro 	cess parameters and appropriate measu	ing technique in	accordance with t
	requirements.			
	 estimate occurring forces and temperatures 	during chip formation.		
	 select appropriate machine tools for machine 	ng and create NC programs for turning an	d milling.	
	 assess the quality of a machine tools and to 	detect weak points.		
Personal Competence				
Social Competence	Students are able to			
	 develop colutions in a production onvironme 	nt with qualified personnel at technical lev	al and represent	docicione
	 develop solutions in a production environme 	nt with qualified personnel at technical lev	rei and represent	decisions.
Autonomy	Students are able to			
Autonomy				
	interpret independently cutting processes.			
	create independently NC programs.			
	 select independently machine tools by refere 			
	assess own strengths and weaknesses in get			
	 assess their learning progress and define ga assess possible consequences of their actior 			
	assess possible consequences of their action	5.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points				
Course achievement	None			
Examination Examination duration and	Written exam 180 min			
Examination duration and scale	100 11111			
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Eng	ineering, Focus F	roduct Developme
	and Production: Compulsory			
2	General Engineering Science (English program, 7	semester): Specialisation Mechanical Eng	ineering, Focus F	roduct Developme
	and Production: Compulsory		-	
	Mechanical Engineering: Specialisation Product Dev	velopment and Production: Compulsory		
	Product Development, Materials and Production: Te			

Course L0689: Fundamentals	s of Machine Tools
	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	
Content	Terminology and trends in machine tool building
	CNC controls
	NC programming and NC programming systems
	Types, construction and function of CNC machines
	Multi-machinesystems
	Equipmentcomponents for machine tools
	Assessment of machine tools
Literature	Conrad, K.J
	Taschenbuch der Werkzeugmaschinen
	9783446406414
	Fachbuchverlag 2006
	Perović, Božina
	Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen
	ISBN: 3540899529
	Berlin [u.a.]: Springer, 2009
	Weck, Manfred
	Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche
	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

ourse L1992: Fundamentals of Machine Tools	
Тур	Recitation Section (large)
Hrs/wk	1
CP	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	ecture		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Wolfgang Hintze		
Language	DE		
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	
CP	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	Typ Hrs/wk CP				
Computer Engineering (L0321)	Lecture 3 4				
Computer Engineering (L0324)	Recitation Section (small) 1 2				
Module Responsible	Prof. Heiko Falk				
Admission Requirements	None				
Recommended Previous	Basic knowledge in electrical engineering				
Knowledge					
Educational Objectives	s After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	 This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: Introduction 				
	 Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses 				
Skills	 The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physicomposition of computer systems. The students can analyze, how highly specific and individual computers can be built based collection of few and simple components. They are able to distinguish between and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comp system and the software executed on it. In particular, they shall understand the consequences that the execution of software 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. 				
D					
Personal Competence					
Social Competence	e Students are able to solve similar problems alone or in a group and to present the results accordingly.				
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	Independent Study Time 124, Study Time in Lecture 56 6				
Course achievement					
course demovement	Yes 10 % Excercises				
Examination	n Written exam				
Examination duration and	I 90 minutes, contents of course and labs				
scale					
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory				
Following Curricula	a 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 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 Mechatron				
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst				
	Engineering: Compulsory				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material: Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory				
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory				

1	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	cture		
Hrs/wk			
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE		
Cycle	WiSe		
Content	 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	ation Section (small)			
Hrs/wk				
СР				
Workload in Hours	pendent Study Time 46, Study Time in Lecture 14			
Lecturer	Heiko Falk			
Language				
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M0599: Integ	rated Product Do	evelopment and	l Lightweigh	t Design			
Courses							
Title CAE-Team Project (L0271) Development of Lightweight Design Products (L0270)			Typ Project-/problem-based Learning Lecture	Hrs/wk 2 2	CP 2 2		
Integrated Product Development I (Lecture	2	2	
Module Responsible							
Admission Requirements							
-		dvanced Knowledge about engineering design:					
Knowledge							
	Fundamentals of Mecha	undamentals of Mechanical Engineering Design					
	Mechanical Engineering	Aechanical Engineering: Design					
	Advanced Mechanical Engineering Design						
Educational Objectives	After taking part succes	ssfully, students have r	eached the followi	ng learning results			
Professional Competence							
Knowledge	After completing the mo	odule, students are cap	able of:				
	 explaining the full 	Inctional principle of 3D)-CAD-Svstems, PD	M- and FEM-Systems			
				the product development proces	5S		
CL 11				· · · ·			
Skills							
	After completing the mo	odule, students are abl	e to:				
			ems with regards	to the desired requirements su	ch as classifica	ation schemes and	
	product structuri	-					
	 design an exemp 	plary product using CAE)-,PDM- and/or FEM	1-Systems with shared workload			
Development Commettened							
Personal Competence	After completing the m	adula, students are abl					
SULIAI CUMPELENCE	After completing the module, students are able 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						
Autonomy	Students are capable of	f:					
	 independently adapt to a CAE-Tool and complete a given practical task with it 						
Workload in Hours	Independent Study Time	e 96, Study Time in Le	cture 84				
Credit points							
Course achievement		Form	Description				
	Yes 20 %	Yes 20 % Subject theoretical and CAE-Teamprojekt inkl. Vortrag und Ausarbeitung					
		practical work					
	Written exam						
Examination duration and	90						
scale Assignment for the	Conoral Engineering	Cionco (Corman prog	rom 7 comester)	: Specialisation Mechanical Eng	incoring Focus	- Aircraft Systems	
Following Curricula	5 5		diii, / semester,	Specialisation mechanical Eng	Illeening, roca.	S Alltrait Systems	
		-	m, 7 semester): S	pecialisation Mechanical Engine	ering, Focus Pro	oduct Development	
	and Production: Compu						
	Engineering Science: Sp	-	al Engineering: Elec	ctive Compulsory			
	General Engineering S	cience (English progr	am, 7 semester):	Specialisation Mechanical Eng	ineering, Focus	Aircraft Systems	
	Engineering: Compulsor	ry					
			n, 7 semester): Sp	pecialisation Mechanical Enginee	ering, Focus Pro	duct Development	
	and Production: Compu						
				ecialisation Mechanical Engineeri	ng: Elective Con	npulsory	
				d Production: Compulsory			
	Mechanical Engineering			ering: Compulsory blementary Course Core Studies:	Elective Comp	loon	
	rioduce bevelopment, i	sidecitals and riodaceic	n. reennear comp	ichically course core staates.	Elective compa	11501 y	

Course L0271: CAE-Team Pro	ject
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	 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: Development	of Lightweight Design Products		
Тур	ture		
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. 		

Course L0269: Integrated Product Development I			
Тур	ture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Dieter Krause		
Language	DE		
Cycle	SoSe		
Content	 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	
Enhanced Fundamentals: Ceramic	-	Lecture	2	2	
Enhanced Fundamentals: Ceramics and Polymers (L1234) Recitation Section (large) 1 1 Enhanced Fundamentals: Metals (L1086) Lecture 2 3					
Admission Requirements		Prof. Gerold Schneider			
Recommended Previous					
Kecommended Previous Knowledge	Module "Fundamentals of Materials Science"				
Kilowieuge	Module "Materials Science Laboratory"				
	Module "Advanced Materials"				
	Module Advanced Materials				
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge	The students are able to give an enhanced over	erview over the following topics			
	in metals, polymers and ceramics: Atomic b	oonds, crystal and amorphous structures,	defects , electrical	and mass transpo	
	microstructure and phase diagrams. They are	capable to explain the corresponding techn	nical terms.		
Skills	The students are able to apply the appropriate	e physical and chemical methods for the al	bove mentioned subj	ects.	
Personal Competence					
Social Competence					
Autonomy	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to critally evaluate the profoundness of their knowledge.				
	be able to critally evaluate the profoundness of their knowledge.				
Workload in Hours	Independent Study Time 110, Study Time in Lo	ecture 70			
Credit points					
Course achievement					
Examination					
Examination duration and					
scale					
Assignment for the	General Engineering Science (German pro	gram 7 semester): Specialisation Mech	hanical Engineering	Focus Materials	
		gran, , seriester, specialisation meet	ingineering,		
•		m, 7 semester): Specialisation Mechanical	Engineering, Focus	Product Developme	
Following Curricula			5		
•	and Production: Compulsory				
•		ipulsory			
•	and Production: Compulsory		ngineering, Focus Ma	aterials in Engineeri	
•	and Production: Compulsory Data Science: Core Qualification: Elective Com		ngineering, Focus Ma	aterials in Engineeri	
-	and Production: Compulsory Data Science: Core Qualification: Elective Com General Engineering Science (English program	n, 7 semester): Specialisation Mechanical E			
•	and Production: Compulsory Data Science: Core Qualification: Elective Com General Engineering Science (English program Sciences: Compulsory	n, 7 semester): Specialisation Mechanical E			
-	and Production: Compulsory Data Science: Core Qualification: Elective Com General Engineering Science (English program Sciences: Compulsory General Engineering Science (English program	n, 7 semester): Specialisation Mechanical E m, 7 semester): Specialisation Mechanical			

Course L1233: Enhanced Fun	damentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	
СР	2
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	
Cycle	Sose 1. Einführung
content	
	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)
	4. Sintern
	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
Literature	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
	Polymerwerkstoffe
	Struktur und mechanische Eigenschaften G.W.Ehrenstein; Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €
	Kunststoffphysik
	W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €
	Werkstoffkunde Kunststoffe
	G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €
	Kunststoff-Kompendium
	A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

Course L1234: Enhanced Fundamentals: Ceramics and Polymers		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner	
Language	DE/EN	
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	Prof. Jörg Weißmüller, Prof. Patrick Huber
Language	DE
Cycle	SoSe
Content	Enhanced Fundamentals of Metals:
	Introduction to phenomenological thermodynamics
	Elasticity
	 Elasticity Thermal materials behavior (heat capacity, thermal expansion)
	 Conductors, semiconductors, isolators: conduction mechanisms and band structure
	Conductors, semiconductors, isolators: conduction mechanisms and band structure Superconductors
	Superconductors Dry corrosion
	Electrochemistry in the material sciences
	Wet corrosion
	Alloy corrosion
	Corrosion protection
	Stainless steel
	Battery materials
	Supercapacitors
	Fuel cells
	Materials for hydrogen storage
	Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism
	Magnetic materials
	Magnetic materials: applications
Literature	Vorlesungsskript

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			Lecture	2	2
Advanced Mechanical Engineering			Recitation Section (large)	2	1
Advanced Mechanical Engineering Advanced Mechanical Engineering			Lecture Recitation Section (large)	2	2 1
			Recitation Section (large)	Z	T
Module Responsible Admission Requirements					
Recommended Previous	None				
Keconnended Previous	Fundamentals of Mechar	ical Engineering Design			
Kilowiedge	Mechanics				
	 Fundamentals of Materia 	ls Science			
	Production Engineering				
Educational Objectives	After taking part successfully, s	tudants have reached the f	allowing loorning results		
	After taking part successfully, s	tudents have reached the h	blowing learning results		
Professional Competence	After passing the medule stud	ante ava abla ta			
Knowledge	After passing the module, stude	ants are able to:			
	explain complex working	principles and functions of	machine elements and of basic ele	ements of fluidics	,
	explain requirements, se	lection criteria, application	scenarios and practical examples o	of complex machi	ne elements,
	 indicate the background 	of dimensioning calculation	s.		
Chille	After passing the module, stude	ants are able to:			
SKIIIS	Arter passing the module, stude	ints are able to.			
	accomplish dimensioning	calculations of covered ma	achine elements,		
	 transfer knowledge learn 	ed in the module to new re	quirements and tasks (problem sol	ving skills),	
	 recognize the content of 	technical drawings and sch	ematic sketches,		
	 evaluate complex design 	s, technically.			
Personal Competence					
Social Competence	Students are able to disc	uss technical information ir	the lecture supported by activatir	g methods.	
Autonomy		ependently deepen their ac	uired knowledge in exercises.		
			and to recapitulate poorly unders	tood content e.g	. by using the vid
	recordings of the lecture	S.		-	
	-				
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112				
Credit points					
Course achievement					
	Written exam				
Examination duration and	120				
scale					
		(German program, 7 seme	ester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
Following Curricula	Engineering: Compulsory				
	5 5	1 5	mester): Specialisation Mechanic	al Engineering,	Focus Materials
Engineering Sciences: Compulsory					
		(German program, 7 ser	nester): Specialisation Mechanica	al Engineering, l	ocus Mechatroni
	Compulsory				
		Jerman program, 7 semest	er): Specialisation Mechanical Eng	ineering, Focus F	
	General Engineering Science (roduct Developme
	and Production: Compulsory				
	and Production: Compulsory General Engineering Science (C	ierman program, 7 semeste	er): Specialisation Mechanical Engi	neering, Focus Th	
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory			-	eoretical Mechanio
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science		er): Specialisation Mechanical Engin nester): Specialisation Mechanica	-	eoretical Mechanio
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory	(German program, 7 sen	nester): Specialisation Mechanica	l Engineering, F	eoretical Mechanio
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science	(German program, 7 sen		l Engineering, F	eoretical Mechanio
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory	(German program, 7 sen	nester): Specialisation Mechanica	l Engineering, F	eoretical Mechanio
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Com	(German program, 7 sen (German program, 7 seme nplementary Course Core SI	nester): Specialisation Mechanica ester): Specialisation Mechanical eudies: Elective Compulsory	l Engineering, F Engineering, Foc	eoretical Mechanie ocus Biomechanie us Energy System
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science	(German program, 7 sen (German program, 7 seme nplementary Course Core SI	nester): Specialisation Mechanica	l Engineering, F Engineering, Foc	eoretical Mechanie ocus Biomechanie us Energy System
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory	(German program, 7 sen (German program, 7 seme nplementary Course Core SI (English program, 7 seme	nester): Specialisation Mechanica ester): Specialisation Mechanical eudies: Elective Compulsory ester): Specialisation Mechanical	I Engineering, F Engineering, Foc Engineering, Foc	eoretical Mechanic ocus Biomechanic us Energy Systen us Aircraft Syster
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E	(German program, 7 sen (German program, 7 seme nplementary Course Core SI (English program, 7 seme	nester): Specialisation Mechanica ester): Specialisation Mechanical eudies: Elective Compulsory	I Engineering, F Engineering, Foc Engineering, Foc	eoretical Mechanic ocus Biomechanic us Energy Systen us Aircraft Syster
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E Sciences: Compulsory	(German program, 7 sen (German program, 7 seme nplementary Course Core Si (English program, 7 semester	nester): Specialisation Mechanica ester): Specialisation Mechanical eudies: Elective Compulsory ester): Specialisation Mechanical): Specialisation Mechanical Engin	I Engineering, F Engineering, Foc Engineering, Foc eering, Focus Mat	eoretical Mechanic ocus Biomechanic us Energy Systen us Aircraft Syster cerials in Engineeri
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E Sciences: Compulsory General Engineering Science	(German program, 7 sen (German program, 7 seme nplementary Course Core Si (English program, 7 semester	nester): Specialisation Mechanica ester): Specialisation Mechanical eudies: Elective Compulsory ester): Specialisation Mechanical	I Engineering, F Engineering, Foc Engineering, Foc eering, Focus Mat	eoretical Mechanic ocus Biomechanic us Energy Systen us Aircraft Syster cerials in Engineeri
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E Sciences: Compulsory General Engineering Science Compulsory	(German program, 7 sen (German program, 7 seme nplementary Course Core SI (English program, 7 seme english program, 7 semester (English program, 7 sem	nester): Specialisation Mechanica ester): Specialisation Mechanical cudies: Elective Compulsory ester): Specialisation Mechanical c): Specialisation Mechanical Engin mester): Specialisation Mechanica	I Engineering, F Engineering, Foc Engineering, Foc eering, Focus Mat I Engineering, I	eoretical Mechanic ocus Biomechanic us Energy Systen us Aircraft Syster erials in Engineeri
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E Sciences: Compulsory General Engineering Science Compulsory General Engineering Science (I	(German program, 7 sen (German program, 7 seme nplementary Course Core SI (English program, 7 seme english program, 7 semester (English program, 7 sem	nester): Specialisation Mechanica ester): Specialisation Mechanical eudies: Elective Compulsory ester): Specialisation Mechanical): Specialisation Mechanical Engin	I Engineering, F Engineering, Foc Engineering, Foc eering, Focus Mat I Engineering, I	eoretical Mechanic ocus Biomechanic us Energy Systen us Aircraft Syster erials in Engineeri
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E Sciences: Compulsory General Engineering Science Compulsory General Engineering Science (I and Production: Compulsory	(German program, 7 sen (German program, 7 sene nplementary Course Core Si (English program, 7 seme inglish program, 7 semester (English program, 7 senester English program, 7 semester	nester): Specialisation Mechanica ester): Specialisation Mechanical rudies: Elective Compulsory ester): Specialisation Mechanical c): Specialisation Mechanical Engin nester): Specialisation Mechanica er): Specialisation Mechanical Eng	I Engineering, F Engineering, Foc Engineering, Foc eering, Focus Mal I Engineering, I ineering, Focus P	eoretical Mechanic ocus Biomechanic us Energy System us Aircraft System erials in Engineeri Focus Mechatronic roduct Developme
	and Production: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory Energy Systems: Technical Con General Engineering Science Engineering: Compulsory General Engineering Science (E Sciences: Compulsory General Engineering Science Compulsory General Engineering Science (I and Production: Compulsory	(German program, 7 sen (German program, 7 sene nplementary Course Core Si (English program, 7 seme inglish program, 7 semester (English program, 7 senester English program, 7 semester	nester): Specialisation Mechanica ester): Specialisation Mechanical cudies: Elective Compulsory ester): Specialisation Mechanical c): Specialisation Mechanical Engin mester): Specialisation Mechanica	I Engineering, F Engineering, Foc Engineering, Foc eering, Focus Mal I Engineering, I ineering, Focus P	eoretical Mechanic ocus Biomechanic us Energy System us Aircraft System erials in Engineeri Focus Mechatronic roduct Developme

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: Advanced Med	chanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	SoSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	• Crank gears
	 Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
	 Dubbel, Taschenbuch f ür 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

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

avT	Lecture
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	
Cycle	
	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	 Linear rolling bearings
	Axes & shafts
	• Seals
	• Clutches & brakes
	Belt & chain drives
	Gear drives
	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-Verlag, aktuelle Auflage.
	 Busber, ruschender für den Maseinnenbad, Groep, KH., Feldhäsen, J. (1139.), 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, aktu
	 Maschineheiemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-verlag, aktu Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.

Course 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		Тур	Hrs/wk	СР	
Signals and Systems (L0432) Signals and Systems (L0433)		Lecture Recitation Section (small)	3 2	4 2	
Module Responsible	Prof Gerhard Bauch	ficeration becauft (sinally	-	-	
Admission Requirements	None				
Recommended Previous	Mathematics 1-3				
Knowledge	Hattenates 1-5				
······································	The modul is an introduction to the theory of signals and				
	1-3 is expected. Further experience with spectral transf	ormations (Fourier series, Fourier tra	ansform, Laplace	transform) is use	
	but not required.				
Educational Objectives	After taking part successfully, students have reached the	following learning results			
Professional Competence					
Knowledge	The students are able to classify and describe signals a	d linear time-invariant (LTI) systems	using methods	of signal and syste	
	theory. They are able to apply the fundamental transfor	mations of continuous-time and disc	rete-time signals	s and systems. Th	
	can describe and analyse deterministic signals and sys	ems mathematically in both time a	nd image domai	n. In particular, th	
	understand the effects in time domain and image dom	ain which are caused by the transi	tion of a continu	ous-time signal to	
	discrete-time signal.				
Skills	The students are able to describe and analyse determin				
	system theory. They can analyse and design basic s				
Demonstration of the second seco	response, stability, linearity etc They can assess the im	bact of LTI systems on the signal pro	perties in time ar	nd frequency doma	
Personal Competence	The should be seen in its block and should be seen if its and blocks				
	The students can jointly solve specific problems.	from oppropriate literature course	They can a	antrol their lovel	
Autonomy	The students are able to acquire relevant information			ontroi their level	
Workload in Hours	knowledge during the lecture period by solving tutorial p	oblems, sortware tools, clicker syste			
	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Course achievement	None Written over				
Examination					
Examination duration and	90 min				
scale	Concret Engineering Science (Cormon program, 7 come	ter). Cresislication Electrical Engine	ning. Compulsor		
Following Curricula	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 semes			ý	
ronowing curricula	General Engineering Science (German program, 7 semes				
	General Engineering Science (German program, 7 semes			orv	
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanica				
	Compulsory				
	General Engineering Science (German program, 7 set	nester): Specialisation Mechanical I	Engineering, Foc	us Energy Systen	
	Compulsory				
	General Engineering Science (German program, 7 se	nester): Specialisation Mechanical	Engineering, Foo	us Aircraft System	
	Engineering: Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials				
	Engineering Sciences: Compulsory				
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	I Engineering, I	Focus Mechatroni	
	Compulsory	ten) Consisting Mashering Frank			
	General Engineering Science (German program, 7 seme: Engineering: Compulsory	iter). Specialisation Mechanical Engli	reening, rocus Ir		
	Computer Science: Core Qualification: Compulsory				
	Electrical Engineering: Core Qualification: Compulsory				
	General Engineering Science (English program, 7 semesi	er): Specialisation Electrical Engineer	ring: Compulsorv		
	General Engineering Science (English program, 7 semest				
	General Engineering Science (English program, 7 semest				
	General Engineering Science (English program, 7 semes	er): Specialisation Bioprocess Engine	ering: Compulso	ry	
	General Engineering Science (English program, 7 semes	er): Specialisation Biomedical Engine	ering: Compulso	ry	
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanica	l Engineering, F	ocus Biomechani	
	Compulsory				
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical I	Engineering, Foc	us Energy Systen	
	Compulsory				
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical	Engineering, Foc	us Aircraft System	
	Engineering: Compulsory				
	General Engineering Science (English program, 7 semes	er): Specialisation Mechanical Engine	eering, Focus Mai	teriais in Engineeri	
	Sciences: Compulsory	montor), Consisting Martin		Focus Mashatas '	
	General Engineering Science (English program, 7 s	emester): specialisation Mechanica	i Engineering, l	rocus Mechatroni	
	Compulsory General Engineering Science (English program, 7 semes	ter): Specialisation Mechanical Engin	eering Focus Th	eoretical Mechani	
	Engineering: Compulsory	eer, specialisation mechanical Engli	icening, rocus In		
	Computational Science and Engineering: Core Qualificati	on: Compulsory			
	Mechatronics: Core Qualification: Compulsory				

Course L0432: Signals and S	vstems
Тур	
Hrs/wk	
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Language	
Cycle	
	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.
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Course L0433: Signals and Systems		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses						
Title		Тур	Hrs/wk	СР		
Heat Transfer (L0458)		Lecture	3	4		
Heat Transfer (L0459)		Recitation Section (large)	2	2		
•						
Admission Requirements	None					
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics					
Knowledge	After taking part successfully, students have reach	ad the following loopping results				
Educational Objectives Professional Competence	After taking part successfully, students have reache	ed the following learning results				
-	The students are able to					
Knowledge	The students are use to					
	- describe the different physical mechanism of Heat	t Transfer,				
	- explain the technical terms,					
	- to analyse comlex heat transfer processes in a cri	tical way.				
Skills	The students are able to					
	understand the physics of Lloop Transfer					
	- understand the physics of Heat Transfer,					
	- calculate and evaluate complex Heat Transfer processes,					
	- solve excersises self-consistent and in small group	25.				
Personal Competence						
Social Competence	The students are able to discuss in small groups an	d develop an approach.				
Autonomy	The students are able to develop a complex proble	m self-consistent and analyse the results i	in a critical way. A	A qualified exchan		
	with other students is given.					
Werkland in Hours	Independent Study Time 110, Study Time in Lestur	- 70				
	Independent Study Time 110, Study Time in Lecture	e 70				
Credit points Course achievement	6 None					
Examination	Written exam					
Examination duration and	120 min					
scale	120 mm					
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Energy System		
Following Curricula			,			
-	General Engineering Science (German program, 7 s	emester): Specialisation Biomedical Engin	eering: Compulso	ory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic					
	Engineering: Elective Compulsory					
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani		
	Engineering: Compulsory					
	Energy Systems: Technical Complementary Course	, ,				
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani		
	Engineering: Elective Compulsory General Engineering Science (English program,	7 semester): Specialisation Machanical	Engineering Foo	us Energy System		
	Compulsory	/ semester). specialisation Mechanical	Linginieering, FOC	us Ellergy System		
	General Engineering Science (English program, 7 se	emester): Specialisation Biomedical Engine	erina: Compulso	rv		
	Mechanical Engineering: Specialisation Energy Syst		5			
	Mechanical Engineering. Specialisation Energy Syst					
	Mechanical Engineering: Specialisation Energy 33st Mechanical Engineering: Specialisation Theoretical		ory			

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

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

Courses				
Title		Тур	Hrs/wk	СР 3
Computational Fluid Dynamics I (L Computational Fluid Dynamics I (L		Lecture Recitation Section (large)	2	3
Module Responsible		Rectation Section (large)	-	5
Admission Requirements Recommended Previous	None			
	Mathematical Methods for Engineers			
Knowledge	Fundamentals of Differential/integral calcu	lus and series expansions		
Educational Objectives	After taking part successfully, students have read	had the following locaning results		
-	After taking part successfully, students have read	ned the following learning results		
Professional Competence	The students are able to list the basis numerics a	f partial differential equations		
Knowledge	The students are able to list the basic numerics o	i partial differencial equations.		
Skills	The students are able develop appropriate pump	rical integration in chace and time for the gr	worning partial di	ifforantial aquatio
SKIIIS	The students are able develop appropriate nume They can code computational algorithms in a stru		overning partial u	
	They can code computational algorithms in a stru	ictured way.		
Personal Competence				
Social Competence	The students can arrive at work results in groups	and document them.		
Autonomy	The students can independently analyse approac	hes to solving specific problems.		
2		5		
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program, 7	7 semester): Specialisation Energy and Envir	omental Engineer	ing: Compulsory
Following Curricula	General Engineering Science (German program, 7	7 semester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical	Engineering, Focu	us Energy System
	Elective Compulsory			
	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical	Engineering, Focu	us Energy Syster
	Compulsory			
	General Engineering Science (German program	n, 7 semester): Specialisation Energy and	Enviromental E	ngineering: Elect
	Compulsory			
	General Engineering Science (German program,	/ semester): Specialisation Mechanical Engli	neering, Focus Th	eoretical Mechan
	Engineering: Elective Compulsory	e Care Studios Flashing Commission		
	Energy Systems: Technical Complementary Cours		Environmental E	
	General Engineering Science (English program	i, / semester): specialisation Energy and	Enviromental El	ngineering: Elect
	Compulsory	competer), Specialization Energy and English	montal Engine	ngi Compulsor
	General Engineering Science (English program, 7	semester): Specialisation Energy and Enviro		
	Conoral Engineering Science (English	7 comoctor), Chocialization Machanist		
	General Engineering Science (English program	, 7 semester): Specialisation Mechanical I	Engineering, Focu	us Energy System
	Elective Compulsory			us Energy System
	Elective Compulsory General Engineering Science (English program, 7	semester): Specialisation Naval Architecture		us Energy Syster
	Elective Compulsory	semester): Specialisation Naval Architecture stems: Elective Compulsory		us Energy System

Course L0235: Computationa	Course L0235: Computational Fluid Dynamics I	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	WiSe	
Content	Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms.	
	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: Computationa	Irse 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	

ourses tle		
	Typ Hrs/wk CP	
mputer Engineering (L0321)	Lecture 3 4	
omputer Engineering (L0324)	Recitation Section (small) 1 2	
Module Responsible	Prof. Heiko Falk	
Admission Requirements	None	
Recommended Previous	Basic knowledge in electrical engineering	
Knowledge	A General Line and an end of the standards have an edited by a fallowing to end on the	
Professional Competence	After taking part successfully, students have reached the following learning results	
-	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly- programming down to gates. The module includes the following topics: • Introduction	
	 Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses 	
Skills	 Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physicomposition of computer systems. The students can analyze, how highly specific and individual computers can be built based in collection of few and simple components. They are able to distinguish between and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comp system and the software executed on it. In particular, they shall understand the consequences that the execution of software on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. 	
Personal Competence		
-	Students are able to solve similar problems alone or in a group and to present the results accordingly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Credit points	6	
Course achievement	Compulsory Bonus Form Description Yes 10 % Excercises	
Examination	Written exam	
Examination duration and	90 minutes, contents of course and labs	
scale	90 minutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory	

1	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 Eng	Course L0321: Computer Engineering		
Тур	Lecture		
Hrs/wk			
CP			
Workload in Hours	ndependent 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
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0662: Nume	erical Mathematics I		
Courses			
Title	Typ Hrs/	/wk	СР
Numerical Mathematics I (L0417)	Lecture 2		3
Numerical Mathematics I (L0418)	Recitation Section (small) 2		3
Module Responsible	Prof. Sabine Le Borne		
Admission Requirements			
Recommended Previous Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + 	II for Tech	nomathematiciar
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
	Students are able to		
			line of the state
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue prol problems and to explain their core ideas 	biems, non	linear root findir
	problems and to explain their core ideas,repeat convergence statements for the numerical methods,		
	 explain aspects for the practical execution of numerical methods, explain aspects for the practical execution of numerical methods with respect to computational 	and storag	e complexitx.
		and storag	e compression
Skills	Students are able to		
	implement, apply and compare numerical methods using MATLAB,		
	 justify the convergence behaviour of numerical methods with respect to the problem and solution associate and supports a suitable solution correctly for a given problem. 	on algorithi	n,
	 select and execute a suitable solution approach for a given problem. 		
Personal Competence			
Social Competence	Students are able to		
	work together in heterogeneously composed teams (i.e., teams from different study programs a	and backer	ound knowlodge
	explain theoretical foundations and support each other with practical aspects regarding the imp		
		iennennennen i	in on argonamion
Autonomy	Students are capable		
	to assess whether the supporting theoretical and practical excercises are better solved individua	allv or in a	team.
	 to assess their individual progess and, if necessary, to ask questions and seek help. 		,
	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
	Written exam		
Examination duration and			
scale			
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compu		Neteriale
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering Sciences: Compulsory	ieening, ro	icus Materiais
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: C	ompulsory	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer		
	Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, F	ocus Theo	retical Mechanic
	Engineering: Compulsory		
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory		
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory		
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory	ocus Theo	retical Mechanic
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory	ocus Theo	retical Mechanic
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	- ocus Theo	retical Mechanic
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Elective Compulsory		retical Mechanic
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Core Qualification: Compulsory	sory	
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul	sory	
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer	lsory ering, Foci	us Biomechanic
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Sciences: Compulsory	lsory ering, Foci ocus Materi	us Biomechanio als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Fo Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Fo	lsory ering, Foci ocus Materi	us Biomechanio als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Fe Sciences: Compulsory	lsory ering, Foci ocus Materi Focus Theo	us Biomechanio als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	lsory ering, Foci ocus Materi Focus Theo	us Biomechanio als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory	lsory ering, Foci ocus Materi Focus Theo	us Biomechanio als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory	lsory ering, Foci ocus Materi Focus Theo	us Biomechani als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory	lsory ering, Foci ocus Materi Focus Theo	us Biomechanio als in Engineeri
	Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering Science (English program, 7 semester): Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compul General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Computational Science and Engineering: Core Qualification: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory	lsory ering, Foci ocus Materi ocus Theo ompulsory	us Biomechanio als in Engineeri

Course L0417: Numerical Ma	thematics I	
Тур	Lecture	
Hrs/wk	2	
CP	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 	

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

Courses				
Title		Тур	Hrs/wk	СР
Production Engineering I (L0608)		Lecture	2	2
Production Engineering I (L0612) Production Engineering II (L0610)		Recitation Section (large) Lecture	1 2	1 2
Production Engineering II (L0611)		Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
-	None			
Recommended Previous	no course assessments required			
Knowledge				
	internship recommended			
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	Students are able to			
	name basic criteria for the selection of	manufacturing processes		
	 name the main groups of Manufacturing 			
	 name the application areas of different 			
	 name boundaries, advantages and disa 	dvantages of the different manufacturing proc	ess.	
	describe elements, geometric propertie	s and kinematic variables and requirements fo	r tools, workpiece	and process.
	 explain the essential models of manufa 	cturing technology.		
Skills	Students are able to			
	 select manufacturing processes in acco 	rdance with the requirements.		
		ple tasks to meet the required tolerances of th	ne component to b	pe produced.
	 assess components in terms of their pro 	oduction-oriented construction.		
Personal Competence				
Social Competence	Students are able to			
	 develop solutions in a production enviro 	onment with qualified personnel at technical le	vel and represent	decisions.
Autonomy	Students are able to			
	 interpret independently the manufactur 	ing process		
	 assess own strengths and weaknesses i 			
	assess their learning progress and defi			
	assess possible consequences of their			
Workload in Hours	Independent Study Time 96, Study Time in Lee	cture 84		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical Eng	gineering, Focus F	Product Developme
Following Curricula	and Production: Compulsory			
	5 5 7 7 5	n, 7 semester): Specialisation Mechanical Eng	ineering, Focus Tł	neoretical Mechani
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qualifica			
	Engineering Science: Specialisation Mechanica			
		n, 7 semester): Specialisation Mechanical Engin		
		n, 7 semester): Specialisation Mechanical Eng	jineering, Focus F	roduct Developme
	and Production: Compulsory	7 competer). Specialization Machanical Faci	pooring Focus Th	oorotical Machani
	Engineering: Elective Compulsory	n, 7 semester): Specialisation Mechanical Engi	neering, rocus Ir	
	Logistics and Mobility: Specialisation Engineer	ing Science: Elective Compulsory		
	Mechanical Engineering: Core Qualification: Co			
	Mechatronics: Core Qualification: Compulsory	. ,		

Course L0608: Production En	gineering I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	WiSe
Content	 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: Production En	urse L0612: Production Engineering I	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wolfgang Hintze	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0610: Production Engineering II		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann	
Language	DE	
Cycle	SoSe	
Content	 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	

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

Courses	
Fitle	Typ Hrs/wk CP
Advanced Mechanical Design Proje	
Module Responsible	
Admission Requirements	None
Recommended Previous	Mechanical Engineering: Design
Knowledge	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	After taking part successfully, students have reached the following learning results
-	After passing the module, students are able to:
Kilowieuge	
	 express the procedure for systematically handling of
	• complex design tasks ,
	 describe working principles, their use and combination possibilities,
	 explain guidelines for designing for function and manufacturing,
	 explain advanced use-oriented knowledge of machine elements.
Skills	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	
Social Competence	After passing the module, students are able to:
	a present and discuss calutions and technical descripts within groups
	 present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the source.
	reflect the own results in the work groups of the course
Autonomy	After passing the module, students are able to:
	 independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select
	appropriate methods,
	 to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
•	6
Course achievement	
	Yes None Attestation
Examination	Written exam
Examination duration and	
scale	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
5	Engineering: Compulsory
Following curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	and Production: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani
	Engineering: Elective Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste
	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm
	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Engineering: Compulsory

Course L0266: Advanced Med	chanical Design Project
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen
Language	DE
Cycle	WiSe
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		Тур	Hrs/wk	СР
Modeling, Simulation and Optimizat	on (L2446)	Integrated Lecture	4	6
Module Responsible	Prof. Benedikt Kriegesmann			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanical E	ngineering, Focus Th	eoretical Mechani
Following Curricula	Engineering: Elective Compulsory			
		rogram, 7 semester): Specialisation Mechanical E	ngineering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Engineering Science: Core Qualification:	1 5		
		ogram, 7 semester): Core Qualification: Compulso	-	
		ogram, 7 semester): Specialisation Mechanical E	ngineering, Focus The	eoretical Mechani
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation T	heoretical Mechanical Engineering: Elective Com	pulsory	

Course L2446: Modeling, Simulation and Optimization	
Тур	Integrated Lecture
Hrs/wk	4
CP	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	

Module M0854: Mathe	ematics IV			
Courses				
Title		Typ	Hrs/wk	СР
Differential Equations 2 (Partial Differential Equations) (L1043)		Typ Lecture	нгs/wк 2	1
Differential Equations 2 (Partial Differential Equations) (L1043)		Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff		Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	he following learning results		
Professional Competence				
Knowledge	Students can name the basis concents in Mathematical Structure (Structure)	matics N/ They are able to evolain ther	n using appropri	ata ayamplas
	 Students can name the basic concepts in Mathematical Students can discuss logical connections between the students can be supported as a student student			
	the help of examples.	en triese concepts. Triey are capable	or muscracing th	ese connections with
		20m		
	 They know proof strategies and can reproduce the strategies and strategies and can reproduce the strategies and strategies an	lem.		
Skills	 Students can model problems in Mathematics I 	V with the help of the concepts studie	ed in this course	. Moreover, they are
	capable of solving them by applying established			-
	Students are able to discover and verify further		pts studied in the	course.
	 For a given problem, the students can develop 	and execute a suitable approach, a	nd are able to c	ritically evaluate the
	results.			
Personal Competence				
Social Competence				
Social competence	Students are able to work together in teams. The	ey are capable to use mathematics as a	a common langu	age.
	 In doing so, they can communicate new concept 	ts according to the needs of their coop	erating partners	. Moreover, they can
	design examples to check and deepen the under	rstanding of their peers.		
Autonomy				
	 Students are capable of checking their understand 		wn. They can sp	ecify open questions
	precisely and know where to get help in solving			
	 Students have developed sufficient persistence 	to be able to work for longer period	s in a goal-orien	ted manner on hard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equ	ations 2)		
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Electrical Enginee	ering: Compulsor	/
Following Curricula				
_	Compulsory		-	
	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechanica
	Engineering: Elective Compulsory	-		
	Computer Science: Specialisation Computational Mathe	ematics: Elective Compulsory		
	Computer Science: Specialisation II. Mathematics and E		ory	
	Electrical Engineering: Core Qualification: Compulsory			
	Engineering Science: Specialisation Electrical Engineeri	ng: Compulsory		
	General Engineering Science (English program, 7 seme		ring: Compulsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Electrical Engineer	ring: Compulsory	
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering, l	ocus Mechatronics
	Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanica
	Engineering: Compulsory			
	General Engineering Science (English program, 7 seme	ster): Specialisation Naval Architecture	: Compulsory	
	Computational Science and Engineering: Specialisation			Ilsory
	Mechanical Engineering: Specialisation Mechatronics: C			
	Mechanical Engineering: Specialisation Theoretical Mec		ory	
	Mechanical Engineering: Specialisation Theoretical Mec			
	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
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

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

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

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

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

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

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.

Courses				
Fitle		Тур	Hrs/wk	СР
Fundamentals of Materials Science I	(L1085)	Lecture	2	2
	(Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Mate		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	lone			
Recommended Previous	lighschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge 1	The students have acquired a fundamental knowledge on r	metals, ceramics and	polymers and can desc	ribe this knowle
c	comprehensively. Fundamental knowledge here means specific	ally the issues of aton	nic structure, microstruct	ure, phase diagra
	phase transformations, corrosion and mechanical properties. T			
	or materials and can identify relevant approaches for cha		roperties. They are able	e to trace mate
ą	phenomena back to the underlying physical and chemical laws	of nature.		
Skills 1	The students are able to trace materials phenomena back t	o the underlying phy	sical and chemical laws	of nature. Mate
F	phenomena here refers to mechanical properties such as stre	ngth, ductility, and sti	iffness, chemical properti	ies such as corro
r	esistance, and to phase transformations such as solidificatio	n, precipitation, or m	elting. The students can	explain the rela
k	between processing conditions and the materials microstruction	ure, and they can acc	ount for the impact of m	nicrostructure or
r	naterial's behavior.			
Personal Competence				
Social Competence -				
Autonomy -				
Workload in Hours	ndependent Study Time 96, Study Time in Lecture 84			
Credit points	5			
Course achievement	lone			
Examination V	Vritten exam			
Examination duration and	.80 min			
scale				
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S			ory
	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S		nd Enviromental Enginee	ring: Compulsory
	Energy and Environmental Engineering: Core Qualification: Con			
	General Engineering Science (English program, 7 semester): Sp			-
	General Engineering Science (English program, 7 semester): Sp			гу
	General Engineering Science (English program, 7 semester): Sp Separal Engineering Science (English program, 7 semester): Sp			ing Compulse
	General Engineering Science (English program, 7 semester): Sp		iu Enviromental Engineer	ing: compulsory
	ogistics and Mobility: Specialisation Engineering Science: Elec Aechanical Engineering: Core Qualification: Compulsory	uve compulsory		
	neenanical Engineering. Core Qualification. Compuisory			
	Aechatronics: Core Qualification: Compulsory			
1	/lechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory			

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

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

Course L1095: Physical and	Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Fritz 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", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer

Courses		
Title	Typ Hrs/wk	СР
Computer Engineering (L0321)	Lecture 3	4
Computer Engineering (L0324)	Recitation Section (small) 1	2
Module Responsible	Prof. Heiko Falk	
Admission Requirements	ts None	
Recommended Previous		
Knowledge		
Educational Objectives		
Professional Competence Knowledge		rom the accombly lo
Knowledge	programming down to gates. The module includes the following topics:	tom the assembly-le
	Introduction	
	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational n	networks
	 Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations 	
	Computer arithmetic: Integer addition, subtraction, multiplication and division	
	Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, caches	
	Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connection	ns, busses
Skills	//s The students perceive computer systems from the architect's perspective, i.e., they identify the internal str	ucture and the physi
Skiis	composition of computer systems. The students can analyze, how highly specific and individual computers	
	collection of few and simple components. They are able to distinguish between and to explain the different	
	today's computing systems - from gates and circuits up to complete processors.	
	After successful completion of the module, the students are able to judge the interdependencies betwee	an a physical compu
	system and the software executed on it. In particular, they shall understand the consequences that the ex-	
	on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will	
	the impact that these low abstraction levels have on an entire system's performance and to propose feasible	
Deveral Commetence		
Personal Competence	ce Students are able to solve similar problems alone or in a group and to present the results accordingly.	
Social Competence	e students are able to solve similar problems alone of in a group and to present the results accordingly.	
Autonomy	ny Students are able to acquire new knowledge from specific literature and to associate this knowledge with ot	ther classes.
Workload in Hours	rs Independent Study Time 124, Study Time in Lecture 56	
Credit points		
Course achievement	t Compulsory Bonus Form Description	
	Yes 10 % Excercises	
	m Written exam	
	d 90 minutes, contents of course and labs	
scale Assignment for the		
Following Curricula		
r onowing curricula	General Engineering Science (German program, 7 semester): Specialisation hispiteess Engineering. Computering	
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compuls	sory
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compu	ulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engine	eering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsor	ry
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering	, Focus Mechatroni
	Compulsory	France Birmarkani
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Compulsory	, Focus Biomechani
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory	Focus Aircraft Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin	g. Focus Materials
	Engineering Sciences: Compulsory	5,
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory	-
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus	Theoretical Mechani
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory	Theoretical Mechani
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus	Theoretical Mechani s Product Developme
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, F Compulsory Compulsory Computer Science: Core Qualification: Compulsory	Theoretical Mechani s Product Developme
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory	Theoretical Mechani s Product Developme
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory	Theoretical Mechani s Product Developme Focus Energy System
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory	Theoretical Mechani s Product Developme Focus Energy Syster
	 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory 	Theoretical Mechani s Product Developme Focus Energy Syster
	 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, F Compulsory Computer Science: Core Qualification: Compulsory Electrical 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 	Theoretical Mechani s Product Developme cocus Energy System
	 General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory 	Theoretical Mechani s Product Developme cocus Energy System lsory

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

Course L0321: Computer Eng	jineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 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 Eng	Course L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Courses				
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4
Signals and Systems (L0432)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge				
-	The modul is an introduction to the theory of signals ar		-	
	1-3 is expected. Further experience with spectral tran	sformations (Fourier series, Fourier tr	ansform, Laplace	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached t	ne following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals	and linear time-invariant (LTI) systems	s using methods (of signal and syste
	theory. They are able to apply the fundamental transf	ormations of continuous-time and dis	crete-time signals	s and systems. Th
	can describe and analyse deterministic signals and sy	stems mathematically in both time a	nd image domai	n. In particular, th
	understand the effects in time domain and image do	main which are caused by the transi	tion of a continu	ious-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determi	nistic signals and linear time-invariant	systems using m	nethods of signal a
	system theory. They can analyse and design basic	systems regarding important proper	ties such as ma	agnitude and pha
	response, stability, linearity etc They can assess the i	mpact of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence				
	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant informat			ontrol their level
	knowledge during the lecture period by solving tutorial	problems, software tools, clicker syste	em.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Electrical Engine	ering: Compulsory	У
Following Curricula	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineering, F	-ocus Biomechani
	Compulsory General Engineering Science (German program, 7 s	mester). Cresislication Mechanical		un Energy Cycher
	Compulsory	emester): specialisation Mechanical	Engineering, Foc	us Energy Syster
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical	Engineering For	cue Aircraft Sveto
	Engineering: Compulsory	emester). Specialisation mechanical	Engineering, roc	Lus Anciait Syste
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering.	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	al Engineering, !	Focus Mechatroni
	Compulsory		5 5,	
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechani
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 seme	ster): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 seme	ster): Specialisation Bioprocess Engine	ering: Compulsor	ry
	General Engineering Science (English program, 7 seme	ster): Specialisation Biomedical Engine	ering: Compulso	ry
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	I Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (English program, 7 se	emester): Specialisation Mechanical	Engineering, Foc	us Energy Syster
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical	Engineering, Foc	cus Aircraft Syste
	Engineering: Compulsory		eering Franking	teriolo in En 1
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical Engin	eering, Focus Mat	teriais in Engineer
	Sciences: Compulsory	comoctor), Cresislinstica Marth	Engineering	Focus Mashatas '
	General Engineering Science (English program, 7 Compulsory	semester): specialisation Mechanica	i Engineering, I	rocus Mechatroni
	Compulsory General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engli	peering Focus Th	eoretical Mochani
	Engineering: Compulsory	seer, specialisation Mechanical Engli	reening, rocus In	
	Computational Science and Engineering: Core Qualifica	tion: Compulsory		
	comparational science and Engineering. Core Qualified	compaisory		
	Mechatronics: Core Qualification: Compulsory			

Course L0432: Signals and S	ystems
Тур	Lecture
Hrs/wk	3
СР	4
Lecturer	
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.
	<u> </u>

Course L0433: Signals and S	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		

Module M0680: Fluid	Dunamica			
	Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics, engineering	mechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to expl Students can scientifically outline the rationale of flow physic performance analysis and the prediciton of fluid engineering	sics using mathematical models a		
Skills	Students are able to apply fluid-engineering principles and enables the student to carry out all necessary theoretical scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develo	op solution strategies.		
Autonomy	The students are able to develop solution strategies for com	plex problems self-consistent and	crtically analyse	results.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Course achievement				
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engin	eering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semester)	: Specialisation Biomedical Engin	eering: Compulso	ry
	General Engineering Science (German program, 7 semester)	: Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (English program, 7 semester):	Specialisation Mechanical Engine	ering: Compulso	гy
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engine	ering: Compulsor	У
	General Engineering Science (English program, 7 semester):	Specialisation Naval Architecture	: Compulsory	
	Computational Science and Engineering: Specialisation Engi	neering Sciences: Elective Compu	lsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science:	Elective Compulsory		

Course L0454: Fluid Mechani	ics
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	SoSe
Content	 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 Mechani	arse L0455: Fluid Mechanics		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Thomas Rung		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses								
Title				Тур	Hrs/wk	СР		
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (L1137)				Lecture Recitation Section (small)	3 2	3 2		
Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (L1138) Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (L1139)				Recitation Section (Iarge)	1	1		
Module Responsible			,		_	_		
Admission Requirements	None							
Recommended Previous	Mathematics I-III and Med	chanics I-III						
Knowledge								
Educational Objectives	After taking part success	fully, students have re	ached the follow	ing learning results				
Professional Competence								
Knowledge	The students can							
	e describe the suism			akau ka				
		natic procedure used in steps in model design;		ilexis;				
	present technical		,					
	prosent coennear	anomeager						
Skills	The students can							
	 explain the import 	ant elements of math	ematical / mech	anical analysis and model for	mation, and appl	y it to the context		
	their own problems;							
	 apply basic metho 	ds to engineering prob	olems;					
	 estimate the reach 	and boundaries of the	e methods and e	 apply basic methods to engineering problems, estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. 				
					•			
					·			
Personal Competence					·			
	The students can work in	groups and support e	ach other to over	rcome difficulties.	·			
Social Competence					·			
Social Competence				rcome difficulties. eaknesses and to organize the	eir time and learn			
Social Competence		determining their own	strengths and we		eir time and learn			
Social Competence Autonomy	Students are capable of o Independent Study Time 6	determining their own 96, Study Time in Lect	strengths and we		eir time and learn			
Social Competence Autonomy Workload in Hours	Students are capable of o Independent Study Time 6 Compulsory Bonus Fo	determining their own 96, Study Time in Lect rm	strengths and we ture 84 Description	eaknesses and to organize the	eir time and learn			
Social Competence Autonomy Workload in Hours Credit points Course achievement	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M	determining their own 96, Study Time in Lect	strengths and we ture 84 Description		eir time and learn			
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam	determining their own 96, Study Time in Lect rm	strengths and we ture 84 Description	eaknesses and to organize the	eir time and learn			
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M	determining their own 96, Study Time in Lect rm	strengths and we ture 84 Description	eaknesses and to organize the	eir time and learn			
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min	determining their own 96, Study Time in Lect mm idterm	strengths and we ture 84 Description Wird nur im	eaknesses and to organize the		ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie	determining their own 96, Study Time in Lect mm idterm	strengths and we ture 84 Description Wird nur im	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engir	eering: Compulse	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie	determining their own 96, Study Time in Lect mm idterm ence (German program ence (German program	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engir	neering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie General Engineering Scie	determining their own 96, Study Time in Lect mm idterm ence (German program ence (German program ence (German program	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp , 7 semester): Sp	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engir Decialisation Biomedical Engin Decialisation Naval Architectur	neering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie General Engineering Scie General Engineering Scie Energy Systems: Technic	determining their own 96, Study Time in Lect mm idterm ince (German program ince (German program ince (German program al Complementary Cou	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp , 7 semester): Sp urse Core Studies	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engir Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory	neering: Compulso reering: Compulso re: Compulsory	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie General Engineering Scie Energy Systems: Technic General Engineering Scie	determining their own 96, Study Time in Lect mm idterm ince (German program ince (German program ince (German program al Complementary Cou ince (English program,	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp urse Core Studies 7 semester): Sp	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engir Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory ecialisation Mechanical Engino	neering: Compulso reering: Compulso re: Compulsory eering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie General Engineering Scie Energy Systems: Technic General Engineering Scie General Engineering Scie General Engineering Scie	determining their own 96, Study Time in Lect mm idterm ince (German program ince (German program ince (German program al Complementary Cou ince (English program, ince (English program,	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp urse Core Studies 7 semester): Sp 7 semester): Sp	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engin Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory ecialisation Mechanical Engine ecialisation Biomedical Engine	neering: Compulso reering: Compulso re: Compulsory eering: Compulso eering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of o Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie	determining their own 96, Study Time in Lect mm idterm ince (German program ince (German program ince (German program al Complementary Cou ince (English program, ince (English program, ince (English program,	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp J semester): Sp 7 semester): Sp 7 semester): Sp 7 semester): Sp	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engir Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory ecialisation Mechanical Engino	neering: Compulso reering: Compulso re: Compulsory eering: Compulso eering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie	determining their own 96, Study Time in Lect mm idterm ince (German program ince (German program ince (German program al Complementary Cou ince (English program, ince (English program, ince (English program, core Qualification: Cor	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp J semester): Sp 7 semester): Sp 7 semester): Sp 7 semester): Sp	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engin Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory ecialisation Mechanical Engine ecialisation Biomedical Engine	neering: Compulso reering: Compulso re: Compulsory eering: Compulso eering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie Mechanical Engineering:	determining their own 96, Study Time in Lect imm idterm ince (German program ince (German program ince (German program al Complementary Cou ince (English program, ince (English program, ince (English program, ince (English program, core Qualification: Cor fication: Compulsory	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp 7 semester): Sp 7 semester): Sp 7 semester): Sp 7 semester): Sp mpulsory	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engin Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory ecialisation Mechanical Engine ecialisation Biomedical Engine	neering: Compulso reering: Compulso re: Compulsory eering: Compulso eering: Compulso	ing based on those		
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are capable of of Independent Study Time 6 Compulsory Bonus Fo No 20 % M Written exam 120 min General Engineering Scie General Engineering Scie	determining their own 96, Study Time in Lect imm idterm ince (German program ince (German program ince (German program al Complementary Cou ince (English program, ince (English program, ince (English program, ince (English program, Core Qualification: Com fication: Compulsory Qualification: Compulsory	strengths and we ture 84 Description Wird nur im , 7 semester): Sp , 7 semester): Sp 7 semester): Sp 7 semester): Sp 7 semester): Sp 7 semester): Sp mpulsory sory	eaknesses and to organize the SoSe angeboten Decialisation Mechanical Engin Decialisation Biomedical Engin Decialisation Naval Architectur S: Elective Compulsory ecialisation Mechanical Engine ecialisation Biomedical Engine	neering: Compulso reering: Compulso re: Compulsory eering: Compulso eering: Compulso	ing based on those		

	(Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	 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
CP	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
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe

 Content
 See interlocking course

 Literature
 See interlocking course

Module M1277: MED	I: Introduction to Anatomy				
Courses					
Title		Тур	Hrs/wk	СР	
Introduction to Anatomy (L0384)		Lecture	2	3	
Module Responsible	Prof. Udo Schumacher				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following learning results			
Professional Competence					
Knowledge	The students can describe basal structures	and functions of internal organs and the m	usculoskeletal system.		
	The students can describe the basic macros	copy and microscopy of those systems.			
Skills	The students can recognize the relationship	between given anatomical facts and the d	evelopment of some cor	nmon diseases: th	
01110	can explain the relevance of structures and	-			
	· · · · · · · · · · · · · · · · · · ·				
Personal Competence					
Social Competence	The students can participate in current disc	ussions in biomedical research and medicir	ne on a professional leve	l.	
Autonomv	The students are able to access anatomica	I knowledge by themselves, can participat	e in conversations on t	he topic and acqui	
	the relevant knowledge themselves.				
	-				
	Independent Study Time 62, Study Time in	Lecture 28			
Credit points	3				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 minutes				
scale					
	General Engineering Science (German prog				
Following Curricula	General Engineering Science (German p	rogram, 7 semester): Specialisation Mec	hanical Engineering, F	ocus Biomechanio	
	Compulsory				
	Electrical Engineering: Specialisation Medic			<u>.</u>	
	General Engineering Science (English pr	ogram, / semester): Specialisation Mec	nanical Engineering, F	ocus Biomechani	
	Compulsory General Engineering Science (English progr	am 7 competer): Specialization Biomodical	Engineering: Compulse	24	
	Mechanical Engineering: Specialisation Bior	•	Engineering. compuisor	у	
	Biomedical Engineering: Specialisation Med		e Compulsory		
	Biomedical Engineering: Specialisation Man				
	Biomedical Engineering: Specialisation Artif				
	Biomedical Engineering: Specialisation Impl	ants and Endoprostheses: Elective Compuls	sory		
	Technomathematics: Specialisation III. Engi	neering Science: Elective Compulsory			

Тур	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tobias Lange
Language	DE
Cycle	SoSe
Content	General Anatomy
	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
	7 th week: Genito-urinary System
	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
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016

Courses						
Fitle		Тур	Hrs/wk CP			
ntroduction to Radiology and Radi	ation Therapy (L0383)	Lecture	2 3			
Module Responsible						
Admission Requirements Recommended Previous	None					
Knowledge	none					
Educational Objectives	After taking part successfully, students have	e reached the following learning results				
Professional Competence						
Knowledge	Therapy The students can distinguish different types	of currently used equipment with respect	to its use in radiation therapy.			
	The students can explain treatment plans us					
	The students can describe the patients	' passage from their initial admittanc	e through to follow-up care.			
	Diagnostics					
	The students can illustrate the technical ba well as sectional imaging techniques (CT, MI		ncluding angiography and mammography, a			
	The students can explain the diagnostic as techniques.	well as therapeutic use of imaging techni	iques, as well as the technical basis for thos			
	The students can choose the right treatmen	t method depending on the patient's clinic	cal history and needs.			
	The student can explain the influence of tec					
		5 5 1				
	The student can draw the right conclusions	based on the images' diagnostic findings (or the error protocol.			
Skills	Therapy The students can distinguish curative and pa	alliative situations and motivate why they	came to that conclusion.			
	The students can develop adequate therapy concepts and relate it to the radiation biological aspects.					
	The students can use the therapeutic principle (effects vs adverse effects)					
	The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the tumor) and choose the energy needed in that situation (irradiation planning).					
	The student can assess what an individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups, social services, psycho-oncology).					
	Diagnostics					
	The students can suggest solutions for repai	irs of imaging instrumentation after bavin	a done error analyses			
	The students can classify results of imagin anatomy, pathology and pathophysiology.	g techniques according to different grou	ups of diseases based on their knowledge			
Personal Competence Social Competence	The students can assess the special social s The students are aware of the special, o measures and can meet them appropriately	ften fear-dominated behavior of sick pe				
Autonomy	The students can apply their new knowledge	e and skills to a concrete therapy case.				
	The students can introduce younger student					
	The students are able to access anatomical and acquire the relevant knowledge themse		te competently in conversations on the top			
Workload in Hours	Independent Study Time 62, Study Time in I	Lecture 28				
Credit points						
Course achievement						
Examination Examination duration and	Written exam					
scale	55 million					
Assignment for the	General Engineering Science (German progr	am, 7 semester): Specialisation Biomedic	al Engineering: Compulsory			
Following Curricula	General Engineering Science (German pr Compulsory	ogram, 7 semester): Specialisation Me	chanical Engineering, Focus Biomechanic			
	Electrical Engineering: Specialisation Medica		chanical Engineering, Focus Biomechanic			
	Compulsory					
	General Engineering Science (English progra Mechanical Engineering: Specialisation Biom		al Engineering: Compulsory			
	Biomedical Engineering: Specialisation Medi		ve Compulsory			
	Biomedical Engineering: Specialisation Mana	agement and Business Administration: Ele	ective Compulsory			
	Biomedical Engineering: Specialisation Artifi					
	Biomedical Engineering: Specialisation Impla	and and Endoprostneses. Elective Compu	1301 y			

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0383: Introduction t	to Radiology and Radiation Therapy
Тур	Lecture
Hrs/wk	2
CP	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Carl, Prof. Thomas Vestring
Cycle	
Content	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments
Literature	• "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 – erschienen 08.12.2009
	ISBN: 978-3-437-47501-6
	"Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus-
	8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012
	ISBN: 978-3-13-567708-8
	"Der Körper des Menschen " von A. Faller u. M. Schünke -
	16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012
	ISBN: 978-3-13-329716-5
	"Praxismanual Strahlentherapie" von Stöver / Feyer –
	1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000

Courses						
Title			Тур		lrs/wk	СР
Embodiment Design and 3D-CAD (L	0268)		Lecture	2		1
Mechanical Design Project I (L0695)			Project-/problem-based	Learning 3		2
Mechanical Design Project II (L0592)		Project-/problem-based	Learning 3		2
Feam Project Design Methodology (L0267)		Project-/problem-based	Learning 2		1
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous						
Knowledge	 Fundamentals 	s of Mechanical Engineering	g Design			
5	 Mechanics 					
	 Fundamentals 	s of Materials Science				
	 Production Er 	ngineering				
Educational Objectives	After taking part sur	cessfully students have re	ached the following learning results			
Professional Competence	, and the same same same same	seessiany, seadenes nave re				
-	After passing the mo	odule, students are able to:				
	· · · · · · · · · · · · · · · · · · ·					
			parts e.g. considering load situation, ma	aterials and n	nanufacturi	ing requirements
	 describe basi 					
	 explain basics 	s methods of engineering d	esigning.			
Skills	After passing the mo	odule, students are able to:				
		-	I drawings and documentations e.g. usi	ng 3D CAD,		
		onents based on design gui				
		alculate) used components,				
			ering design tasks systamtically and sol	ution-oriente	d,	
	 apply creativity 	ity techniques in teams.				
Personal Competence						
Social Competence	After passing the mo	odule, students are able to:				
	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods. 					
	 moderate the use of scientific methods, present and discuss solutions and technical drawings within groups 					
	 present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 					
	 reflect the ow 	in results in the work group	is of the course.			
Autonomy	Students are able					
	 to optimate t 	bair loval of knowladge usi	ng activating mothods within the lactur	oc (o a with	clickors)	
	 to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), To solve engineering design tasks systematically. 					
	- To solve engr	neering design tasks system	hateany.			
Workload in Hours	Independent Study	Time 40, Study Time in Lec	ture 140			
Credit points						
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Written elaboration	Konstruktionsprojekt 2 3D-CAD-Praktikum			
	Yes None	Written elaboration Written elaboration		k		
	Yes None Yes None	Written elaboration	Teamprojekt Konstruktionsmethodi Konstruktionsprojekt 1	N		
Examination	Written exam		Konstruktionspi Ujekt 1			
Examination Examination duration and						
Examination duration and scale	100					
	Conoral Engineering	Science (Cormon program	7 competer). Specialization Machanica	Engineering	. Compuls	201
Assignment for the Following Curricula			a, 7 semester): Specialisation Mechanication Representation Represe Representation Representation Represention Representation Representation Representation Representati			-
Following Curricula						
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory					
	Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory					
				Enviromonte		
			7 semester): Specialisation Energy and		-	
			7 semester): Specialisation Mechanical			-
			7 semester): Specialisation Biomedical	Engineering:	Compulsor	у
	-	ring: Core Qualification: Co	inpuisory			
	Machatranica, Com	Qualification: Compulsory				

Course L0268: Embodiment I	Design and 3D-CAD
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	WiSe
Content	 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. Maschinenelemente, Band I-III; Niemann, G., 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: Mechanical Design Project I		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	Prof. Thorsten Schüppstuhl	
Language	DE	
Cycle	WiSe	
Content	 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: Mechanical Design Project II	
Тур	Project-/problem-based Learning
Hrs/wk	3
CP	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.

rse L0267: Team Project	
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				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
•				
Admission Requirements	None			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics	5		
Knowledge	After teling net guessefully, students have reach	ed the following lookning results		
Educational Objectives Professional Competence	After taking part successfully, students have reach	ed the following learning results		
-	The students are able to			
Knowledge	The statents are able to			
	- describe the different physical mechanism of Hea	t Transfer,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a cr	itical way.		
Skills	The students are able to			
	understand the physics of Uset Transfer			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer pro	ocesses,		
	- solve excersises self-consistent and in small grou	ps.		
	some excersises sen consistent and in small grou			
Personal Competence				
Social Competence	The students are able to discuss in small groups ar	nd develop an approach.		
Autonomy	The students are able to develop a complex proble	em self-consistent and analyse the results	in a critical way. A	A qualified exchan
	with other students is given.			
Werkland in Hours	Independent Study Time 110, Study Time in Lestu			
	Independent Study Time 110, Study Time in Lectur	e 70		
Credit points Course achievement	6 None			
Examination	Written exam			
Examination duration and	120 min			
scale	120 mm			
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Energy System
Following Curricula		·	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
-	General Engineering Science (German program, 7	semester): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechani
	Engineering: Compulsory			
	Energy Systems: Technical Complementary Course			
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanical Engli	neering, Focus Th	eoretical Mechani
	Engineering: Elective Compulsory General Engineering Science (English program,	7 comester): Specialisation Machanical	Engineering For	us Energy System
	Compulsory	/ semester). specialisation Mechanical	Lingineering, FOC	us Ellergy Systen
	General Engineering Science (English program, 7 s	emester): Specialisation Biomedical Engine	eering: Compulso	rv
	Mechanical Engineering: Specialisation Energy Sys		5	
	Mechanical Ligineering. Specialisation Liferdy Sys			
	Mechanical Engineering: Specialisation Energy Sys		ory	

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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Andreas Moschallski
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0662: Nume	erical Mathematics I	
Courses		
Title	Typ Hrs/wk CP	
Numerical Mathematics I (L0417)	Lecture 2 3	
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3	
Module Responsible	Prof. Sabine Le Borne	
Admission Requirements	s None	
Recommended Previous	5	
Knowledge	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathen basic MATLAB knowledge 	maticia
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence	3	
Knowledge	e Students are able to	
	name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear roo	ot findi
	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 completed 	exitx.
Skills	s Students are able to	
	 implement, apply and compare numerical methods using MATLAB, 	
	 justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm, 	
	 select and execute a suitable solution approach for a given problem. 	
	• select and execute a suitable solution approach for a given problem.	
Personal Competence	3	
Social Competence	e Students are able to	
	 work together in heterogeneously composed teams (i.e., teams from different study programs and background kno 	
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algor	rithms.
Autonomy	y Students are capable	
<i>Haterlehiy</i>		
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team, 	
	 to assess their individual progess and, if necessary, to ask questions and seek help. 	
Werkleed in Heure	a Jadanandant Chudu Tina 194 Chudu Tina in Lastura EC	
	s Independent Study Time 124, Study Time in Lecture 56	
Credit points		
Course achievement		
Examination	n Written exam	
Examination duration and	al 90 minutes	
scale		
Assignment for the	e General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory	
Following Curricula	a General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mate	erials
	Engineering Sciences: Compulsory	critats
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	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory	crititis
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome	
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	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Me Engineering: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory	echanio
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	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biome Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Me Engineering: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory	echani
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Course L0417: Numerical Mathematics I		
Тур	Lecture	
Hrs/wk	2	
CP	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
CP	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

Courses						
Title				Тур	Hrs/wk	СР
Practical Course: Measurement and Control Systems (L1119)				Practical Course	2	2
Measurement Technology for Mechanical Engineering (L1116)				Lecture	2	3
Measurement Technology for Mech	anical Engineering (L111	3)		Recitation Section (large)	1	1
Module Responsible	Prof. Thorsten Kern					
Admission Requirements	None					
Recommended Previous	Basic knowledge of physics, chemistry and electrical engineering					
Knowledge						
Educational Objectives	After taking part succe	essfully, students have	reached the follow	ing learning results		
Professional Competence						
Knowledge	Students are able to r	name the most import	ant fundmentals o	f the Measurement Techno	logy (Quantities and	d Units, Uncertaiı
	Calibration, Static and	d Dynamic Properties of	f Sensors and Syst	ems).		
	They can outline the	most important measu	ring methods for	different kinds of quantities	s to be maesured (Electrical Quantit
		ical quantities, Flow, T				Liectifedi qualiti
	They can describe imp	ortant methods of che	mical Analysis (Ga	s Sensors, Spectroscopy, Ga	as Chromatography))
Skills	Students can select su	itable measuring meth	ods to given probl	ems and can use refering m	easurement devices	s in practice.
	The students are able	to orally explain issue	s in the subject ar	ea of measurement techno	logy and solution a	pproaches as wel
		he right context and ap				
Personal Competence						
Social Competence	Students can arrive at	work results in groups	and document the	m in a common report.		
Autonomy	Students are able to fa	amiliarize themselves w				
			num new measurem	ient technologies.		
Workload in Hours		me 110, Study Time in I		lent technologies.		
Workload in Hours Credit points		ne 110, Study Time in I		ient technologies.		
	Independent Study Tir	ne 110, Study Time in Form		ient technologies.		
Credit points	Independent Study Tir 6		Lecture 70 Description	ient technologies.		
Credit points	Independent Study Tir 6 Compulsory Bonus	Form	Lecture 70 Description	ient technologies.		
Credit points	Independent Study Tir 6 Compulsory Bonus Yes None	Form Subject theoretical	Lecture 70 Description			
Credit points Course achievement	Independent Study Tir 6 Compulsory Bonus Yes None Written exam	Form Subject theoretical	Lecture 70 Description			
Credit points Course achievement Examination	Independent Study Tir 6 Compulsory Bonus Yes None Written exam	Form Subject theoretical	Lecture 70 Description			
Credit points Course achievement Examination Examination duration and scale	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes	Form Subject theoretical practical work	Lecture 70 Description and	pecialisation Mechanical En	gineering: Compulse	ory
Credit points Course achievement Examination Examination duration and scale	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S	Form Subject theoretical practical work	Description and m, 7 semester): S			
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S	Form Subject theoretical practical work cicience (German progra cicience (German progra cicience (German progra	Description and m, 7 semester): S m, 7 semester): S m, 7 semester): S	pecialisation Mechanical En	gineering: Compulso	bry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical Eng	Form Subject theoretical practical work cicience (German progra cicience (German progra cicience (German progra cicience (German progra pineering: Core Qualific	Description and and m, 7 semester): S m, 7 semester): S m, 7 semester): S ation: Compulsory	pecialisation Mechanical En pecialisation Biomedical En pecialisation Energy and En	gineering: Compulso	bry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme	Form Subject theoretical practical work cicience (German progra cicience (German progra cicience (German progra pineering: Core Qualific ental Engineering: Core	Description and m, 7 semester): S m, 7 semester): S m, 7 semester): S ation: Compulsory Qualification: Com	pecialisation Mechanical En pecialisation Biomedical En pecialisation Energy and En	gineering: Compulso	bry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S	Form Subject theoretical practical work icience (German progra icience (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechatro	Description and m, 7 semester): S m, 7 semester): S m, 7 semester): S ation: Compulsory Qualification: Com nics: Compulsory	pecialisation Mechanical En pecialisation Biomedical En pecialisation Energy and En pulsory	gineering: Compulso	bry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S	Form Subject theoretical practical work icience (German progra icience (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechanic Specialisation Mechanic	Description and and and and and and and and and an	pecialisation Mechanical En pecialisation Biomedical En pecialisation Energy and En pulsory mpulsory	gineering: Compulso	bry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S	Form Subject theoretical practical work icience (German progra icience (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechatro Specialisation Mechanic Specialisation Biomedic	Description and and and and and and and and and an	pecialisation Mechanical En pecialisation Biomedical En pecialisation Energy and En pulsory mpulsory ctive Compulsory	gineering: Compulso	ory ring: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S	Form Subject theoretical practical work science (German progra science (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechanic Specialisation Mechanic Specialisation Biomedic science (English program	Description and and and and and and and and and an	Decialisation Mechanical En Decialisation Biomedical En Decialisation Energy and En Inpulsory Impulsory Inctive Compulsory ecialisation Energy and Env	gineering: Compulsc viromental Engineer riromental Engineeri	ory ring: Compulsory ing: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S General Engineering S General Engineering S General Engineering S	Form Subject theoretical practical work icience (German progra icience (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechanic Specialisation Mechanic Specialisation Biomedic icience (English progra icience (English program	Description and and and and and and and and and an	pecialisation Mechanical En- pecialisation Biomedical En- pecialisation Energy and En- apulsory mpulsory ecialisation Energy and En- ecialisation Energy and En-	gineering: Compulso viromental Engineer riromental Engineeri ineering: Compulso	ory ring: Compulsory ing: Compulsory ry
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S	Form Subject theoretical practical work icience (German progra icience (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechanic Specialisation Mechanic Specialisation Mechanic science (English progra icience (English progra icience (English progra icience (English progra icience (English progra icience (English progra	Description and and and and and and and and and an	pecialisation Mechanical En- pecialisation Biomedical En- pecialisation Energy and En- pulsory ecialisation Energy and En- ecialisation Energy and En- ecialisation Mechanical Eng ecialisation Biomedical Eng ecialisation Mechatronics: C	gineering: Compulso viromental Engineeri ineering: Compulso ineering: Compulso Compulsory ineering: Compulsor	ory ring: Compulsory ing: Compulsory ry ry ry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Tir 6 Compulsory Bonus Yes None Written exam 105 minutes General Engineering S General Engineering S Digital Mechanical Eng Energy and Environme Engineering Science: S Engineering Science: S General Engineering S Mechanical Engineering	Form Subject theoretical practical work icience (German progra icience (German progra gineering: Core Qualific ental Engineering: Core Specialisation Mechanic Specialisation Mechanic Specialisation Mechanic Specialisation Biomedic icience (English progra icience (English progra icience (English progra icience (English progra icience (English progra icience (English progra	Description and and and and am, 7 semester): Sp ation: Compulsory Qualification: Com unics: Compulsory cal Engineering: Co al Engineering: Co al Engineering: Co al Engineering: Co al Engineering: Sp n, 7 semester): Sp	pecialisation Mechanical En- pecialisation Biomedical En- pecialisation Energy and En- apulsory ecialisation Energy and Env ecialisation Energy and Env ecialisation Mechanical Eng ecialisation Mechatronics: C ecialisation Mechanical Eng	gineering: Compulso viromental Engineeri ineering: Compulso ineering: Compulso Compulsory ineering: Compulsor	ory ring: Compulsory ing: Compulsory ry ry ry

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

Course L1116: Measurement	: 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	WiSe 1 Fundamentals
Content	1.1 Quantities and Units 1.2 Uncertainty
	1.3 Calibration 1.4 Static and Dynamic Properties of Sensors and Systems
	2 Measurement of Electrical Quantities
	2.1 Current and Voltage 2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope
	2.5 Analog-to-Digital Conversion
	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
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3.
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.

Course L1118: Measurement	ourse L1118: Measurement Technology for Mechanical Engineering		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	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		

Courses				
Title		Тур	Hrs/wk	СР
Introduction to Biochemistry and M	olecular Biology (L0386)	Lecture	2	3
Module Responsible	Prof. Hans-Jürgen Kreienkamp			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe basic biomolecules; 			
	explain how genetic information	on is coded in the DNA;		
	explain the connection between	n DNA and proteins;		
Skille	The students can			
SKIIIS				
	 recognize the importance of m 	olecular parameters for the course of a disease;		
	 describe selected molecular-di 	5 1 .		
	 explain the relevance of these 	procedures for some diseases		
Personal Competence				
•	The students can participate in discu	ssions in research and medicine on a technical leve	èl.	
Autonomy	The students can develop understand	ling of topics from the course, using technical litera	ature, by themselves.	
Workload in Hours	Independent Study Time 62, Study Ti	me in Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (Germa	n program, 7 semester): Specialisation Biomedical	Engineering: Compulso	ry
Following Curricula	General Engineering Science (Gerr	nan program, 7 semester): Specialisation Mech	anical Engineering, Fo	ocus Biomechanio
	Compulsory			
	Data Science: Specialisation Medicine			
		Medical Technology: Elective Compulsory		
	Engineering Science: Specialisation B	program, 7 semester): Specialisation Biomedical E	nginooring, Compulsor	
		ish program, 7 semester): Specialisation Biomedical L		-
	Compulsory	ish program, y semestery, specialisation neen	unicul Engineering, re	biomeenum
	Mechanical Engineering: Specialisatio	on Biomechanics: Compulsory		
		n Management and Business Administration: Electi	ive Compulsory	
	Biomedical Engineering: Specialisatic	n Artificial Organs and Regenerative Medicine: Elec	ctive Compulsory	
	Biomedical Engineering: Specialisatic	n Medical Technology and Control Theory: Elective	Compulsory	
	Biomedical Engineering: Specialisatio	n Implants and Endoprostheses: Elective Compulso	ory	

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

Module M1333: BIO I:	Implants and Fracture Healing	9		
Courses				
Title		Тур	Hrs/wk	СР
Implants and Fracture Healing (L03		Lecture	2	3
Module Responsible				
Admission Requirements				
	It is recommended to participate in "Introduc	tion into Anatomie" before attending "Impla	nts and Fracture Heal	ing".
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students can describe the different ways	s 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	i.
Skills	The students can determine the forces acting	g within the human body under quasi-static	situations under speci	fic assumptions.
Personal Competence				
•	The students can, in groups, solve basic num	nerical modeling tasks for the calculation of i	internal forces.	
Autonomy	The students can, in groups, solve basic num	nerical modeling tasks for the calculation of	internal forces.	
Workload in Hours	Independent Study Time 62, Study Time in L	ecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mech	anical Engineering, F	ocus Biomechanic
Following Curricula	Compulsory			
	General Engineering Science (German progra	am, 7 semester): Specialisation Biomedical B	Engineering: Compulso	ory
	Engineering Science: Specialisation Biomedia	cal Engineering: Compulsory		
	General Engineering Science (English progra	m, 7 semester): Specialisation Biomedical E	ngineering: Compulsor	У
	General Engineering Science (English pro	gram, 7 semester): Specialisation Mecha	anical Engineering, F	ocus Biomechanic
	Compulsory			
	Mechanical Engineering: Specialisation Biom			
	Biomedical Engineering: Specialisation Artific			
	Biomedical Engineering: Specialisation Impla			
	Biomedical Engineering: Specialisation Media	cal Technology and Control Theory: Elective	Compulsory	
	Biomedical Engineering: Specialisation Mana	gement and Business Administration: Electiv	ve Compulsory	
	Orientierungsstudium: Core Qualification: Ele			
	Technomathematics: Specialisation III. Engin	eering Science: Elective Compulsory		

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

Courses					
Title			Тур	Hrs/wk	СР
Introduction into Medical Technology and Systems (L0342)			Lecture	2	3
Introduction into Medical Technolog			Project Seminar	2	2
			Recitation Section (large)	1	1
Module Responsible Admission Requirements	None	chlaefer			
Recommended Previous		h (algebra, analysis/calculu	s)		
	principles of stor		5,		
······································		ramming, R/Matlab			
Educational Objectives	After taking part	successfully, students have	e reached the following learning results		
Professional Competence					
Knowledge			dical technology, including imaging systems	-	
	information syste	ems. They are able to give	an overview of regulatory affairs and standard	s in medical technol	ogy.
Skills	The students are	able to evaluate systems a	and medical devices in the context of clinical a	pplications.	
Devecuel Commetence					
Personal Competence	The students des	ariba a problem in medical	technology on a preject, and define technology	and column in a join	t offort
Social Competence	The students des	cribe a problem in medical	technology as a project, and define tasks that	are solved in a join	t enort.
Autonomy	The students car	n reflect their knowledge a	nd document the results of their work. They	can present the rest	ults in an appropria
	manner.				
Workload in Hours	Independent Stur	dy Time 110, Study Time ir	Lecture 70		
Credit points		ay nine 110, Study nine ir			
Course achievement	Compulsory Bonus	Form	Description		
course demeterment	Yes 10 %	Written elaboration			
	Yes 10 %	Presentation			
Examination	Written exam				
Examination duration and	90 minutes				
scale					
Assignment for the	General Engineer	ring Science (German prog	am, 7 semester): Specialisation Biomedical Er	igineering: Compuls	ory
Following Curricula	Computer Science	e: Specialisation Computer	and Software Engineering: Elective Compulso	ry	
	Computer Science	e: Specialisation II. Mathen	natics and Engineering Science: Elective Comp	ulsory	
	Data Science: Co	re Qualification: Elective C	ompulsory		
	-	ering: Core Qualification: E			
			cal Engineering: Compulsory		
	-		am, 7 semester): Specialisation Biomedical En		-
			ecialisation II. Mathematics & Engineering Scie		ulsory
	·	5 5 1	ecialisation Computer Science: Elective Comp		
			ecialisation Engineering Sciences: Elective Col		
	-		cial Organs and Regenerative Medicine: Electi ants and Endoprostheses: Elective Compulsory		
	-		cal Technology and Control Theory: Elective Compulsory		
	-		agement and Business Administration: Elective C		
	Siomearcar Engli	seemig. Specialisation Mall	agement and business Authinistration. Elective	2 compaisory	

Course L0342: Introduction i	Course L0342: Introduction into Medical Technology and Systems		
Тур	Lecture		
Hrs/wk	2		
CP	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: Introduction into Medical Technology and Systems		
Тур	Project Seminar	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Alexander Schlaefer	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1876: Introduction i	nto Medical Technology and Systems
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	SoSe
Content	- 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
ntroduction to Physiology (L0385)		Lecture	2	3
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe the basics of the energy 	v metabolism:		
		in selected fields of muscle, heart/circulation, r	neuro- and sensory physic	ology.
			icare and sensory physic	0.0991
Skills		of basic bodily functions (sensory, transmission	n and processing of infor	mation, developm
	of forces and vital functions) and relate	them to similar technical systems.		
Personal Competence				
Social Competence		n research and medicine on a technical level.		
	The students can find solutions to prob	lems in the field of physiology, both analytical	and metrological.	
Autonomv	The students can derive answers to g	uestions arising in the course and other phys	siological areas, using te	chnical literature
	themselves.			
	Independent Study Time 62, Study Tim	e in Lecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Biomedic	al Engineering: Compulse	ory
Following Curricula	General Engineering Science (Germa	n program, 7 semester): Specialisation Me	echanical Engineering, F	Focus Biomechan
	Compulsory			
	Data Science: Specialisation Medicine:			
		edical Technology: Elective Compulsory		
		medical Engineering: Elective Compulsory		
		h program, 7 semester): Specialisation Me	echanical Engineering, F	ocus Biomechan
	Compulsory	warmen Zaamaatan) Caasialiaatian Diawaadia		
		rogram, 7 semester): Specialisation Biomedica		-
		rogram, 7 semester): Specialisation Biomedica	al Engineering: Elective C	ompulsory
	Mechanical Engineering: Specialisation		ivo Compulsony	
		Medical Technology and Control Theory: Elect Management and Business Administration: Elect		
		Artificial Organs and Regenerative Medicine: E		
		Implants and Endoprostheses: Elective Compu		
		Engineering Science: Elective Compulsory		

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

Courses				
Title Experimental Methods in Biomecha	inics (L0377)	Typ Lecture	Hrs/wk	СР 3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Implanta	te und Frakturheilung" before attending	"Experimentelle Methode	en".
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students can describe the different ways The students can name different treatments			
	The students can describe different measure given task.	nent techniques for forces and moveme	nts, and choose the adeq	uate technique fo
Skills	The students can describe the basic handling	of several experimental techniques use	d in biomechanics.	
Personal Competence				
Social Competence	The students can, in groups, solve basic expe	rimental tasks.		
Autonomy	The students can, in groups, solve basic expe	rimental tasks.		
Workload in Hours	Independent Study Time 62, Study Time in Le	ecture 28		
Credit points	3			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Me	echanical Engineering, F	ocus Biomechani
Following Curricula	Compulsory			
	General Engineering Science (German progra		al Engineering: Compulso	ry
	Engineering Science: Specialisation Biomedic			
	General Engineering Science (English pro	gram, 7 semester): Specialisation Me	chanical Engineering, Fo	ocus Biomechani
	Compulsory			
	General Engineering Science (English program			-
	General Engineering Science (English program		al Engineering: Elective Co	ompulsory
	Mechanical Engineering: Specialisation Biome		lasting Commuter and	
	Biomedical Engineering: Specialisation Artific			
	Biomedical Engineering: Specialisation Implan		-	
	Biomedical Engineering: Specialisation Medic Biomedical Engineering: Specialisation Manage			
	Technomathematics: Specialisation III. Engine		cuve compuisory	

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

Specialization Naval Architecture

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

Module M0833: Introd	duction to Control Systems			
Courses				
Title		Тур	Hrs/wk	СР
Introduction to Control Systems (LC	0654)	Lecture	2	4
Introduction to Control Systems (LC	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous Knowledge	Representation of signals and systems in time and t	frequency domain, Laplace transform		
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge Skills Personal Competence Social Competence Autonomy	 Students can represent dynamic system beh first and second order systems They can explain the dynamics of simple con root locus They can explain the Nyquist stability criteric They can explain the role of the phase margi They can explain the way a PID controller aff They can explain issues arising when control Students can transform models of linear dyna They can design PID controllers with the help They can analyze and synthesize simple cont They can use standard software tools (Matlat Students can work in small groups to jointly solve to Students can obtain information from provided so when solving given problems. They can assess their knowledge in weekly on-line to 	atrol loops and interpret dynamic properties on and the stability margins derived from in n in analysis and synthesis of control loop ects a control loop in terms of its frequence lers designed in continuous time domain a amic systems from time to frequency dom f systems and control loops of heuristic (Ziegler-Nichols) tuning rules irrol loops with the help of root locus and fi mations of controllers designed in cor o Control Toolbox, Simulink) for carrying o echnical problems, and experimentally va urces (lecture notes, software document	es in terms of free it. is cy response are implemented nain and vice vers requency respons ntinuous-time an out these tasks lidate their contro tation, experimen	quency response and digitally a e techniques d use it for digital
	Independent Study Time 124, Study Time in Lecture	2 56		
Credit points				
Course achievement				
Examination Examination duration and				
scale	120 11111			
Assignment for the	General Engineering Science (German program, 7 s	emester): Specialisation Computer Science	e. Compulsory	
Following Curricula	General Engineering Science (German program, 7 s			ory
	General Engineering Science (German program, 7 s General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering Science (German program, 7 s Engineering: Compulsory General Engineering Science (German program, 7 s Engineering: Compulsory General Engineering Science (German program, 7 and Production: Compulsory	emester): Specialisation Naval Architectu emester): Specialisation Civil Engineering emester): Specialisation Electrical Engine emester): Specialisation Biomedical Engine emester): Specialisation Energy and Envir emester): Specialisation Process Engineer 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 8, 7 semester): Specialisation Mechanical 9, 7 semester): Specialisation Mechanical 9, 7 semester): Specialisation Mechanical 9, 7 semester): Specialisation Mechanical 9, 8, 8, 9, 9, 9, 9, 9, 9, 9, 9, 9, 9, 9, 9, 9,	re: Compulsory : Compulsory ering: Compulsory neering: Compulsor romental Enginee ring: Compulsory al Engineering, F Engineering, Foc cal Engineering, neering, Focus Th	y pry ring: Compulsory Focus Mechatronics: Focus Biomechanics: cus Aircraft Systems Focus Materials in neoretical Mechanical

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 Oualification: Compulsory Energy and Environmental Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computational Science and Engineering: Core Qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Oualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core Qualification: Compulsory

Тур	Lecture
Hrs/wk	
CP	4
	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
	Bode diagram
	Minimum and non-minimum phase systems
	Nyquist plot, Nyquist stability criterion, phase and gain margin
	Loop shaping, lead lag compensation Erequency receases interpretation of PID control
	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	- Warney II. Leekure Nakee, Jakreduction to Central Custer
	Werner, H., Lecture Notes "Introduction to Control Systems" C.F. Frenklin, J.D. Pewell and A. Frenzik Nacini "Feedback Central of Dynamic Systems". Addison Weeley, Deeding, MA 2
	G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2 K. Orata "Medare Control Engineering" Equith Edition. Brantice Hall, Upper Saddle Biyer, NJ, 2010.
	 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
	 N.C. Don and N.H. Bishop, Modern Control Systems, Addison Wesley, Reading, MA 2010

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	programming down to gates. The module includes the		s the layers from	n the assembly-lev
	Introduction Combinational logic: Catos, Realean algebra, R	alean functions, hardware synthesis, co	mhinational not	worke
	 Combinational logic: Gates, Boolean algebra, B Sequential logic: Flip-flops, automata, systemational systemation is subsequential logic: Flip-flops, automata, systematical sy			WULKS
	Technological foundations			
	Computer arithmetic: Integer addition, subtract	ion, multiplication and division		
	Basics of computer architecture: Programming		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, or			
	• Input/output: I/O from the perspective of the CF	PU, principles of passing data, point-to-p	oint connections,	busses
C1:11-				
SKIIIS	The students perceive computer systems from the arc composition of computer systems. The students can a			
	collection of few and simple components. They are a			
	today's computing systems - from gates and circuits u		and and amercill	assuration layers
	cours s comparing systems more gates and circuits o			
	After successful completion of the module, the stude			
	system and the software executed on it. In particular			
	on the hardware-centric abstraction layers from the a			
	the impact that these low abstraction levels have on a	an entire system's performance and to p	ropose feasible o	options.
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in	n a group and to present the results acco	ordingly.	
Autonomy	Students are able to acquire new knowledge from spe	cific literature and to associate this know	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	Compulsory Bonus Form De	scription		
	Yes 10 % Excercises			
	Written exam			
	90 minutes, contents of course and labs			
scale				
Assignment for the				
Following Curricula				ory
	General Engineering Science (German program, 7 sen	•		
	General Engineering Science (German program, 7 sen General Engineering Science (German program, 7 sen			,
	General Engineering Science (German program, 7 sen			
	General Engineering Science (German program, 7 sen		5	·
	General Engineering Science (German program, 7 sen		-	5. 25. paisory
	General Engineering Science (German program, 7 General Engineering Science (German program, 7			
		' semester): Specialisation Mechanica		-ocus Mechatroni
	Compulsory	' semester): Specialisation Mechanica		-ocus Mechatroni
			l Engineering, F	
	Compulsory		l Engineering, F	
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical		ocus Biomechani
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanic	Engineering, Foc al Engineering,	iocus Biomechani us Aircraft Syste Focus Materials
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory	semester): Specialisation Mechanical semester): Specialisation Mechanical 1 7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir	Engineering, Foc al Engineering, neering, Focus Th	iocus Biomechani us Aircraft Syste Focus Materials eoretical Mechani
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser	semester): Specialisation Mechanical semester): Specialisation Mechanical 1 7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir	Engineering, Foc al Engineering, neering, Focus Th	ocus Biomechani us Aircraft Syste Focus Materials eoretical Mechani
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanic mester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi	Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P	iocus Biomechani us Aircraft Syste Focus Materials reoretical Mechani roduct Developm
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanic mester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi	Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P	iocus Biomechani us Aircraft Syste Focus Materials reoretical Mechani roduct Developme
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	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical Engi semester): Specialisation Mechanical E	Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc	iocus Biomechani us Aircraft Syste Focus Materials reoretical Mechani roduct Developm us Energy Syster
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical Engi semester): Specialisation Mechanical E ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine	Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc : Compulsory ering: Compulsor	iocus Biomechani us Aircraft Syste Focus Materials reoretical Mechani roduct Developm us Energy Syster
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical Engi semester): Specialisation Mechanical E ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine ester): Specialisation Naval Architecture	Engineering, Foc al Engineering, meering, Focus Th ineering, Focus P Engineering, Foc : Compulsory ering: Compulsory :: Compulsory	iocus Biomechani us Aircraft Syste Focus Materials reoretical Mechani roduct Developm us Energy Syster
	Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	semester): Specialisation Mechanical semester): Specialisation Mechanical I 7 semester): Specialisation Mechanical Engin mester): Specialisation Mechanical Engin mester): Specialisation Mechanical Enginester): Specialisation Mechanical Engine ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine ester): Specialisation Naval Architecture ester): Specialisation Naval Architecture ester): Specialisation Civil Engineering:	Engineering, Focus al Engineering, meering, Focus Th ineering, Focus P Engineering, Focus Engineering, Focus : Compulsory Compulsory Compulsory ring: Compulsory ring: Compulsory	ocus Biomechani us Aircraft Syste Focus Materials eoretical Mechani roduct Developm us Energy Syster

	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
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
5	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
ā	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
	Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
r	Mechatronics: Core Qualification: Compulsory
۲ ا	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	jineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE
Cycle	WiSe
Content	 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 Eng	jineering
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				
		Tree	line (suit	CD.
Title Management Tutorial (L0882)		Typ Recitation Section (large)	Hrs/wk 2	CP 3
Introduction to Management (L088	0)	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	After taking this module, students know the impo and Organisation to Marketing and Innovation, an			
	 explain the differences between Econom important definitions from the field of Mana 		lines in Manage	ment and to na
	explain the most important aspects of and	d goals in Management and name the mos	t important aspe	cts of entreprneu
	projects			
	describe and explain basic business fun			
		ement, information management, innovation		
	 explain the relevance of planning and d uncertainty, and explain some basic method 		tions under mui	tiple objectives a
	 state basics from accounting and costing a 			
	and costing a			
Skills	Students are able to analyse business units with out an Entrepreneurship project in a team. In part		ojectives, strateg	es etc.) and to ca
	analyse Management goals and structure t	hem appropriately		
	analyse organisational and staff structures	of companies		
	apply methods for decision making under r	nultiple objectives, under uncertainty and ur	nder risk	
	analyse production and procurement syste	ms and Business information systems		
	 analyse and apply basic methods of market 	ting		
	 select and apply basic methods from mathematical select and apply basic m			
	 apply basic methods from accounting, cost 	ing and controlling to predefined problems		
Personal Competence				
Social Competence	Students are able to			
	 work successfully in a team of students to apply their knowledge from the lecture to 	a an antropropourchip project and write a co	abarant rapart an	the project
	 to apply their knowledge from the lecture t to communicate appropriately and 	o an entrepreneurship project and write a co	Sherenc report on	the project
	 to cooperate respectfully with their fellow s 	students		
Autonomy	Students are able to			
	 work in a team and to organize the team the 	nemselves		
	 to write a report on their project. 			
	· · · · · · · · · · · · · · · · · · ·			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	170.70		
Credit points				
Credit points				
Course achievement				
Course achievement Examination				
Course achievement Examination Examination duration and	several written exams during the semester			
Course achievement Examination Examination duration and scale	several written exams during the semester	semester): Specialisation Electrical Engineer	erina: Compulson	1
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7	-		1
Course achievement Examination Examination duration and scale	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Process Engineer	ing: Compulsory	
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7	semester): Specialisation Process Engineer	ing: Compulsory eering: Compulso	
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Process Engineer semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur	ing: Compulsory eering: Compulso e: Compulsory	
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Process Engineer semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science	ing: Compulsory eering: Compulsory e: Compulsory e: Compulsory	pry
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine	ing: Compulsory eering: Compulsory e: Compulsory e: Compulsory eering: Compulsor	pry
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering:	ing: Compulsory eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory Compulsory	pry
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Process Engineer semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Enviro	ing: Compulsory eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory Compulsory omental Engineer	ory ory ring: Compulsory
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program, 7	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Envir m, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory Compulsory omental Engineer il Engineering, I	ory ory ring: Compulsory Focus Mechatroni
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Envir m, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory e: Compulsory eering: Compulsory Compulsory omental Engineer il Engineering, I	ory ory ring: Compulsory Focus Mechatroni
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environ n, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory eering: Compulsory omental Engineering, 1 I Engineering, F	ory ring: Compulsory Focus Mechatroni Focus Biomechan
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environ n, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory eering: Compulsory omental Engineering, 1 I Engineering, F	ory ring: Compulsory Focus Mechatroni Focus Biomechan
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environ n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory eering: Compulsory omental Engineer I Engineering, F Engineering, Foc	ory ring: Compulsory Focus Mechatroni Focus Biomechan sus Aircraft Syste
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environ n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory eering: Compulsory omental Engineer I Engineering, F Engineering, Foc	ory ring: Compulsory Focus Mechatron Focus Biomechan cus Aircraft Syste
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Science (German program Engineering: Science (German program	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engini semester): Specialisation Naval Architecturi semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environm, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory omental Engineer I Engineering, F Engineering, Foc al Engineering, Foc	ory ring: Compulsory Focus Mechatron Focus Biomechan sus Aircraft Syste Focus Materials
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 Seneral Engineering Science (German program), 7 Seneral Engineering Science (Serman program), 7 Seneral Serma Serma program), 7 Seneral Serma Serma Serma program), 7 Seneral Serma Serma Serma Serma pro	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engini semester): Specialisation Naval Architecturi semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environm, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory omental Engineer I Engineering, F Engineering, Foc al Engineering, Foc	ory ring: Compulsory Focus Mechatron Focus Biomechan sus Aircraft Syste Focus Materials
Course achievement Examination Examination duration and scale Assignment for the	several written exams during the semester General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Science (German program Engineering: Science (German program	 semester): Specialisation Process Engineeri semester): Specialisation Biomedical Engin semester): Specialisation Naval Architectur semester): Specialisation Computer Science semester): Specialisation Bioprocess Engine semester): Specialisation Civil Engineering: semester): Specialisation Energy and Environ m, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanica 	ing: Compulsory eering: Compulsory e: Compulsory eering: Compulsory compulsory omental Engineer I Engineering, F Engineering, Foc al Engineering, Foc al Engineering, The eering, Focus Th	ory ring: Compulsory Focus Mechatron Focus Biomechan cus Aircraft Syste Focus Materials reoretical Mechan

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

Course L08	82: Management Tutorial
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload	Independent Study Time 62, Study Time in Lecture 28
in Hours	
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 se 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 busine 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: Introduction t	o Management				
Тур	Lecture				
Hrs/wk	3				
CP	3				
Workload in Hours	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	DE				
Cycle	WiSe/SoSe				
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovatio Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informatio Management Definitions as information, information systems, aspects of data security and strategic 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., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Au Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.				
	Weber, J., Schaner, O. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.				

Module M0854: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	CP
Differential Equations 2 (Partial Diff Differential Equations 2 (Partial Diff		Lecture Recitation Section (small)	2 1	1
Differential Equations 2 (Partial Diff		Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Chudanta and many the basis and sub-in Mathematica ()	(The surger of the first state of the surger of the surge		
	Students can name the basic concepts in Mathematics IV Chudents can discuss logical connections between these			
	 Students can discuss logical connections between these the belo of eventues 	concepts. They are capable	of illustrating th	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce them. 			
Skills	Students can model problems in Mathematics IV with the second secon	ne help of the concepts studie	ed in this course	. Moreover, they are
	capable of solving them by applying established methods	5.		
	Students are able to discover and verify further logical co	onnections between the conce	pts studied in the	e course.
	 For a given problem, the students can develop and ex 	ecute a suitable approach, a	nd are able to c	ritically evaluate the
	results.			
Personal Competence				
Social Competence				
	 Students are able to work together in teams. They are called a state of the state o			
	 In doing so, they can communicate new concepts accord 		erating partners	. Moreover, they can
	design examples to check and deepen the understanding	g of their peers.		
Autonomy	 Students are capable of checking their understanding of complex concepts on their own. They can specify open question 			ecify open questions
	precisely and know where to get help in solving them.			
	 Students have developed sufficient persistence to be a 	ble to work for longer period	s in a goal-orien	ted manner on hard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equations 2)			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Electrical Enginee	ering: Compulsor	V
Following Curricula				
5	Compulsory		5 5.	
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engir	neering, Focus Th	neoretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Architectur	e: Compulsory	
	Computer Science: Specialisation Computational Mathematics:	Elective Compulsory		
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Electrical Engineer	ring: Compulsory	
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanica	l Engineering, l	Focus Mechatronics:
	Compulsory			
	General Engineering Science (English program, 7 semester): S	pecialisation Mechanical Engin	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Sp			
	Computational Science and Engineering: Specialisation II. Mathe			ilsory
	Computational Science and Engineering: Specialisation Comput		-	
	Computational Science and Engineering: Specialisation Enginee		Isory	
	Mechanical Engineering: Specialisation Theoretical Mechanical I			
	Mechanical Engineering: Specialisation Mechatronics: Compulso	ory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory		Comment	
	Theoretical Mechanical Engineering: Technical Complementary	course core studies: Elective	compulsory	

Course L1043: Differential Equations 2 (Partial Differential Equations)			
Тур	ecture		
Hrs/wk			
CP	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dozenten des Fachbereiches Mathematik der UHH		
Language	DE		
Cycle	SoSe		
Content	Main features of the theory and numerical treatment of partial differential equations		
Literature	 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 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html 		

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

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

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

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

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

Courses						
Title			Тур	Hrs/wk	СР	
Mechanics IV (Kinetics II, Oscillatio			Lecture	3	3	
	Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) (L1138)			2	2	
Mechanics IV (Kinetics II, Oscillatio		ody Systems) (L1139)	Recitation Section (large)	1	1	
Module Responsible						
Admission Requirements	None					
Recommended Previous Knowledge	Mathematics I-III and Mecha	nics I-III				
	After taking part successful	v students have reached t	a following loarning rocults			
Professional Competence	Arter taking part succession	y, students have reached t				
-	The students can					
, and the dige						
		ic procedure used in mecha	inical contexts;			
	explain important ste					
	 present technical know 	owledge.				
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 in groups and support each other to overcome difficulties. Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those					
Workload in Hours	Independent Study Time 96	Study Time in Lecture 84				
Credit points						
Course achievement	Compulsory Bonus Form	Des	ription			
	No 20 % Midt	erm Wir	d nur im SoSe angeboten			
Examination	Written exam					
Examination duration and	120 min					
scale						
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory					
Following Curricula General Engineering Science (German program, 7 semester): Specialisation Biomedical E			-			
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory Energy Systems: Technical Complementary Course Core Studies: Elective Compulsory					
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulso General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulso			irv			
			ster): Specialisation Naval Architectur			
	Mechanical Engineering: Co	re Qualification: Compulsor	у			
	Mechatronics: Core Qualifica	ation: Compulsory				
	Naval Architecture: Core Qualification: Compulsory					
	Technomathematics: Specia		ence: Elective Compulsory mentary Course Core Studies: Elective			

Course L1137: Mechanics IV	(Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems)		
Тур	ecture		
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	
CP	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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Robert Seifried	
Language	DE	
Cycle	SoSe	

 Content
 See interlocking course

 Literature
 See interlocking course

Madula MOCOO, Eluid	Dumonico			
Module M0680: Fluid	Dynamics			
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (L0454)		Lecture	3	4
Fluid Mechanics (L0455)		Recitation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics, engineering me	echanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids Students can scientifically outline the rationale of flow physics using mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices.			
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on a scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop solution strategies.			
Autonomy	The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results.		results.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): S	Specialisation Mechanical Engin	eering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 semester): S	Specialisation Biomedical Engine	eering: Compulso	ry
	General Engineering Science (German program, 7 semester): S	Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (English program, 7 semester): S	pecialisation Mechanical Engine	ering: Compulso	ſУ
	General Engineering Science (English program, 7 semester): S	pecialisation Biomedical Engine	ering: Compulsor	У
	General Engineering Science (English program, 7 semester): S	pecialisation Naval Architecture	: Compulsory	
	Computational Science and Engineering: Specialisation Engine	ering Sciences: Elective Compu	lsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: El	ective Compulsory		

Course L0454: Fluid Mechanics		
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	SoSe	
Content	 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 Mechani	ourse L0455: Fluid Mechanics	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Ship Dynamics (L0352)		Lecture	2	3
Ship Dynamics (L1620)		Recitation Section (small)	1	1
	in Naval Architecure and Ocean Engineering (L0364)	Lecture	2	3
	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	None			
Recommended Previous Knowledge	Technical mechanicsLinear algebra, analysis, complex numbersFluid mechanics			
Educational Objectives	After taking part successfully, students have reached t	ne following learning results		
Professional Competence				
Knowledge	 The students are able to give an overview over various procedure of the manoeuvres. 	us manoeuvres. They can name applic	ation goals and t	hey can describe t
	- The students are able to give an overview over varius	rudder types. They can name criteria	n the rudder des	ign.
	- The students can name computation methods which a	are used to determine forces and motic	ons in waves.	
Skills	 The students can come up with the equations of motion The students are able to determine hydrodynamic code 			e and linearise the
	- The students can explain how a rudder works and the	y can explain the physical effects whic	h can occur.	
	- The students can mathematically describe waves.			
	- The students can explain the mathematically descript	ion of harmoncial motions in waves an	d they can deter	mine them.
Personal Competence				
Social Competence	- The students can arrive at work results in groups and	document them.		
	- The students can discuss in groups and explain their p	point of view.		
Autonomy	- The students can assess their own strengthes and we	aknesses and the define further work s	teps on this basi	S.
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70			
Credit points	7			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architectur	e: Compulsory	
Following Curricula	General Engineering Science (English program, 7 seme	•		
	Naval Architecture: Core Qualification: Compulsory	, , , , , , , , , , , , , , , , , , ,		

Course L0352: Ship Dynamic	S
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Moustafa Abdel-Maksoud
Language	DE
Cycle	SoSe
Content	Maneuverability of ships
	Equations of motion
	Hydrodynamic forces and moments
	Linear equations and their solutions
	Full-scale trials for evaluating the maneuvering performance
	Regulations for maneuverability
	• Rudder
	Seakeeping
	- Democratation of harmonic processor
	 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
	Eulig-term distribution of sedway initialities
Literature	 Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut f ür Fluiddynamik und Schiffstheorie, Technische Universit ät
	 Abder-Massoud, M., Schnischenk, Vollesungsskript, Institut für Fluiddynamik und Schnischeore, Technische Universität Hamburg-Harburg, 2014
	 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University o 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. Berlin 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, Jarcey City, NJ, 1980.
	Marine Engineers, Jersey City, NJ, 1989
	Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004 Level A. Ship Rehaviour in Reuch Weather. Cospect: Chickester, Sussey, United Vipedem, 1908
	Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998

Course L1620: Ship Dynamic	ourse 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	

Tvp	Lecture
Hrs/wk	
	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Sven Wassermann
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, John 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	CP
Fundamentals of Ship Structural De	sian (10411)	Lecture	2	2
Fundamentals of Ship Structural De	5	Recitation Section (small)	1	2
Fundamentals of Ship Structural An		Lecture	2	2
Fundamentals of Ship Structural An		Recitation Section (small)	1	2
Module Responsible	Prof. Sören Ehlers			
Admission Requirements				
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - III			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	Students can reproduce the basic contents of the	structural behaviour of ship structures; the	y can explain the	theory and metho
	for the calculation of deformations and stresses in	beam-like structures.		
	Furthermore, they can reproduce the basis conte		ed products, join	ing and principles
	structural design of components in the ship struct	ure.		
Skills	Students are capable of applying the methods a	and tools for the calculation of linear def	ormations and st	tresses in the abo
	mentioned structures; they can choose calculation models of typical ship structures.			
	Furthermore, they are conclude to explute the model	ada of drawing and sining the ship structu		at avitable mestavia
	Furthermore, they are capable to apply the meth	bas of drawing and sizing the ship structu	re; they can sele	LL SUILADIE MALENA
	semi-finished products and joints.			
Personal Competence				
-	The students are able to communicate and coop	erate in a professional environment in th	e shinhuilding an	d component supr
Social competence	industry.		e shipbulung un	
	industry.			
Autonomy	The students are capable to independently ideali	ze real ship structures and to select suita	ble methods for a	analysis of beam-li
	structures; they are capable to assess the results	of structural analyses.		
	Furthermore, they are capable to assess draw	ings of complex ship structures and to	design ship st	ructures for vario
	requirements and boundary conditions.			
	Independent Study Time 156, Study Time in Lecture	re 84		
Credit points				
	None			
Examination	Written exam			
Examination duration and	3 hours			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Naval Architectu	re: Compulsory	
Following Curricula	General Engineering Science (English program, 7	semester): Specialisation Naval Architectur	e: Compulsory	

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

Course L0413: Fundamentals	
	Recitation Section (small)
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	WiSe
Content	Chapters:
	1. Introduction
	3. Class societies and their tasks
	4. Materials for steel shipbuilding
	5. Welding and Cutting
	6. Semi-finished products in steel shipbuilding
	7. Determining the scantlings for local loads
	8. Longitudinal strength of the hull girder
	9. Determining the scantlings of longitudinal structural members
	10. Determining the scantlings of bottom and side structures
	11. Decks and Hatch Openings
	12. Effective breadth
	13. Iterative determination of scantlings (POSEIDON)
Literature	Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht

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

Course L0414: Fundamentals	ourse L0414: Fundamentals of Ship Structural Analysis	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	WiSe	
Content	Contents:	
	1. Introduction	
	2. Finite element method (f.e. method) by the example of trussworks	
	3. Force methods for frameworks	
	4. F.e. method for frameworks	
	5. Shear and torsion in thin-walled beams	
	6. Beams subjected to longitudinal forces	
Literature	Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente	

Courses				
Title		Түр	Hrs/wk	СР
Ship Structural Design (L0412)		Lecture	2	3
Ship Structural Design (L0415)		Recitation Section (small)	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Sören Ehlers			
Admission Requirements	None			
Recommended Previous	Mechanics I - III			
Knowledge	Fundamentals of Materials Science I - III			
	Welding Technology I			
	Fundamentals of Mechanical Design I - II	I		
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence	÷, ,			
Knowledge	Students can reproduce design and sizin	ng as well as fabrication of the different areas of sh	nip structures and o	of different ship typ
	(incl. detail design); they can describe ca	alculation models for complex structures.		
	components, to select suitable calculation	on models and to assess the chosen structure		
Personal Competence				
	Students are capable to present their str		tivoly in a group	
Social Competence	· · · · · · · · · · · · · · · · · · ·	ructural design and discuss their decisions construc	cively in a group.	
		ndently different structural areas of the ship hull		types and to def
				types and to def
	Students are capable to design independent appropriate fabrication methods.	ndently different structural areas of the ship hull		types and to def
Autonomy	 Students are capable to design independent propriate fabrication methods. Independent Study Time 172, Study Time 	ndently different structural areas of the ship hull		types and to def
Autonomy Workload in Hours	 Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time 9 	ndently different structural areas of the ship hull		types and to def
Autonomy Workload in Hours Credit points	 Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time 9 None 	ndently different structural areas of the ship hull		types and to def
Autonomy Workload in Hours Credit points Course achievement	 Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time 9 None Written exam 	ndently different structural areas of the ship hull		types and to def
Autonomy Workload in Hours Credit points Course achievement Examination	 Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time 9 None Written exam 3 hours 	ndently different structural areas of the ship hull		types and to def
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	 Students are capable to design independent appropriate fabrication methods. Independent Study Time 172, Study Time 9 None Written exam 3 hours 	ndently different structural areas of the ship hull	and different ship	types and to def

Course L0412: Ship Structural Design	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	Chapters:
	 Bulkheads and tanks Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships 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

Hrs/wk 2 Q 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecture For. Sören Ehlers Language DE 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 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 10. Production-kind steel structural design	Тур	Recitation Section (small)
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. Structural design of forebodies 3. Structural design of forebodies 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 10. Production-kind steel structural design	Hrs/wk	2
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	CP	3
Language DE Cycle SoSe Content Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 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	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Cycle SoSe Content Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 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	Lecturer	Prof. Sören Ehlers
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	Language	DE
 Bulkheads and tanks Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design Buckling and ultimate strength 	Cycle	SoSe
 Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design Buckling and ultimate strength 	Content	Chapters:
12. Safety factors and reliability of structures		 Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design

Course L1123: Welding Tech	nology
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	
Cycle	
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
	- deposition welding
	- electron beam welding/ laser beam welding
	- weld joint designs and declarations
	- computation methods for weld joint dimensioning
Literature	Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005.
	Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002.

Courses				
Title		Тур	Hrs/wk	СР
Resistance and Propulsion (L1265)		Lecture	2	3
Resistance and Propulsion (L1266)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Mechanics			
Knowledge	 Fluid Dynamics for Naval Architects 			
	Hydrostratics			
	• Hydrostraties			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant fo	r resistance and propulsion of ships are	discussed. The	different resistan
	phenomena and their practical applications to hu	llform design as well as numerical and emp	irical prediction	methods are subje
	of the course. Furthermore, environmental additi	onal resistances are dealt with. The course	e includes model	test techniques a
	their application to full scale ships. This hold also	o for propulsion and hullefficiency elements	s, mainly thrust o	deduction and wak
	Main Focus is how hull forms can be optimized for	minimum and sustainable fuel consumption	. The following to	opics are dealt with
	- Stillwater/added resistance, Wave resistance,	Minimization of wave resistance numeric	al prediction me	thods friction law
	laminar/turbulent flow separation, Hull form des			
	resistance law,form factor method, thrust deduct	5 1 1 1	5 5	
	propeller basics, propulsion tests, full scale spee			
	EEDI, speed trials, contractual matters concerning		(wind, steering,	current, seu stat
		speed, poner, samer clams		
Skills	tills The student shall learn to design competitve hull forms with respect to fuel consumption by applying numreical techniques		al techniques and	
	evaluate these hulls by several progosis meth	nods. Furtermore, the course will enable t	he student to c	learl determine a
	minimize the required power including environme	ntal influences.		
Personal Competence				
	The student learns to prepare technical matters in	such a way that he can compte with his bu	ilding suvervisior	ı team.
Autonomy	The student learns to prepare technical matters in	such a way that he can compte with his bu	ilding suvervisior	n team.
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	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Naval Architectur	e: Compulsory	
Following Curricula	General Engineering Science (English program, 7	•		
Following curricula	General Engineering Science (English program, 7.	semester). Specialisation Naval Architecture	. Compuisory	

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

Course L1266: Resistance an	ourse L1266: Resistance and Propulsion	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Stefan Krüger	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (LO	235)	Lecture	2	3
Computational Fluid Dynamics I (LO	419)	Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Mathematical Mathematical Concernation			
Knowledge	Mathematical Methods for Engineers Eurodamontals of Differential/integral			
	 Fundamentals of Differential/integral 	r calculus and series expansions		
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
Professional Competence				
Knowledge	The students are able to list the basic nume	erics of partial differential equations.		
Skills	The students are able develop appropriate	numerical integration in space and time for the	governing partial d	ifferential equatio
	They can code computational algorithms in	a structured way.		
Personal Competence				
	The students can arrive at work results in g	roups and document them		
Social Competence	The students can arrive at work results in g	roups and document them.		
Automore	The students can independently analyse an			
Autonomy	The students can independently analyse ap	proaches to solving specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in	n Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German prog	ram, 7 semester): Specialisation Energy and En	viromental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German prog	ram, 7 semester): Specialisation Naval Architect	ure: Compulsory	
	General Engineering Science (German pr	ogram, 7 semester): Specialisation Mechanica	l Engineering, Foc	us Energy Syster
	Elective Compulsory			
		ogram, 7 semester): Specialisation Mechanica	l Engineering, Foc	us Energy Syster
	Compulsory			
		rogram, 7 semester): Specialisation Energy a	nd Enviromental E	ingineering: Elect
	Compulsory			
		gram, 7 semester): Specialisation Mechanical En	gineering, Focus In	ieoretical Mechani
	Engineering: Elective Compulsory	/ Course Core Studies: Elective Compulsory		
		ogram, 7 semester): Specialisation Energy a	nd Enviromental E	naineerina: Elect
	Compulsory	ogram, 7 semester, specialisation Energy di		ingineering. Liett
		ram, 7 semester): Specialisation Energy and Env	iromental Engineeri	ina: Compulsory
		ogram, 7 semester): Specialisation Energy and Env ogram, 7 semester): Specialisation Mechanica		
	Elective Compulsory			
		ram, 7 semester): Specialisation Naval Architectu	ure: Compulsory	
	Mechanical Engineering: Specialisation Ene			
	Naval Architecture: Core Qualification: Com			

Course L0235: Computationa	al 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.
	 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

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

ourses					
itle		Тур	Hrs/wk	СР	
undamentals of Materials Science I	I (L1085)	Lecture	2	2	
undamentals of Materials Science I	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2	
hysical and Chemical Basics of Mat	terials Science (L1095)	Lecture	2	2	
Module Responsible	Prof. Jörg Weißmüller				
Admission Requirements	None				
Recommended Previous	Highschool-level physics, chemistry und mathematics				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	ring learning results			
Professional Competence	····· · · · · · · · · · · · · · · · ·				
-	The students have acquired a fundamental knowledge on r	netals. ceramics and	polymers and can desci	ribe this knowle	
	comprehensively. Fundamental knowledge here means specific				
	phase transformations, corrosion and mechanical properties. Th				
	for materials and can identify relevant approaches for cha	racterizing specific p	roperties. They are able	to trace mater	
	phenomena back to the underlying physical and chemical laws	of nature.			
Skille	The students are able to trace materials phonomena back t	a tha undarlying phy	reical and chamical laws	of patura Mata	
	The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materia phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosid				
	resistance, and to phase transformations such as solidificatio				
	between processing conditions and the materials microstructu				
	material's behavior.			icrostructure on	
Personal Competence					
Social Competence					
Autonomy					
	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	180 min				
	General Engineering Science (German program, 7 semester): S	pecialisation Mechani	al Engineering: Compulse	orv	
-	General Engineering Science (German program, 7 semester): S				
-	General Engineering Science (German program, 7 semester): S				
	General Engineering Science (German program, 7 semester): S		-	5	
	General Engineering Science (German program, 7 semester): S				
	Data Science: Specialisation Materials Science: Compulsory		, ,		
	Digital Mechanical Engineering: Core Qualification: Compulsory				
	Energy and Environmental Engineering: Core Qualification: Con	npulsory			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Energy ar	nd Enviromental Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanic	al Engineering: Compulsor	ſУ	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Arc	hitecture: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Biomedica	al Engineering: Compulsor	У	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Arc	hitecture: Compulsory		
	Logistics and Mobility: Specialisation Engineering Science: Elect	ive Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory				
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Compulsory				

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

Course L1095: Physical and O	Chemical Basics of Materials Science
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Fritz 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", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer

	statics and Body Plan			
ourses				
tle ydrostatics (L1260)		Typ Lecture	Hrs/wk	CP 3
vdrostatics (L1260)		Recitation Section (large)	2	1
ody Plan (L1452)		Project Seminar	2	2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in Mathemathics I-III and Mechanics I-III.			
	It is recommended that the students are familiar with typical de	esign relevant drawings, e.g. B	ody Plan, GA- Pla	an, Tank Plan etc.
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	The lecture enables the student to carry out all necessary theo			ific level. The lectu
	is basic requirement for all following lectures in the subjects sh	po design and safety of ships.		
Skills	The student is able to carry out hydrostatic calculations to en	sure that the ship has sufficie	ent stability. He i	s able to design h
	forms that are safe against capsizing or sinking.			
Personal Competence				
Social Competence	The student gets access to hydrostatical problems.			
Autonomy				
	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	180 min			
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Architectur	e. Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture	e: Compulsory	
	General Engineering Science (English program, 7 semester): Sp	ecialisation Naval Architecture	e: Compulsory	
	Naval Architecture: Core Qualification: Compulsory			
ourse L1260: Hydrostatics				
	Lecture			
Hrs/wk	2			
Hrs/wk CP				
СР				
CP Workload in Hours Lecturer	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger			
CP Workload in Hours Lecturer Language	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integral - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integral - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integral - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Floating Condition - Hydrostatic Tables and Sounding Tables	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation	ion Methods		
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves - Heeling Moments of Free Surfaces, Water on Deck, Water In			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves - Heeling Moments of Free Surfaces, Water on Deck, Water In			
CP Workload in Hours Lecturer Language Cycle	3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integrat - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves - Heeling Moments of Different Type			

- 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
- 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

Literature	1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig
	2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin
	3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.

Course L1261: Hydrostatics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1452: Body Plan	
Тур	Project Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of : - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.
Literature	 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 Homepage abrufbar.

Courses				
itle		Тур	Hrs/wk	СР
hip Design (L1262)		Lecture	2	3
hip Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous Knowledge	Fluid Dynamics for Naval Architects, ResiResistance and Propulsion, Hydrostatics	stance and Propulsion		
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	The lecture starts with an overview about the Ship Designs are thoroughly discussed. Typical main parameters of a ship are introduced and influence of alternated main parameters on the lecture, the design changes are dealt with by systems properly so that the relavent technical The lecture continues with an introduction into contract. Further, methods are introduced to g during the different design stages. In detail, the - Structure of a building specification - Determination of Light Ship Weight and Deadw Components - Design of main section and hull form - Design of main propulsion plant - Design of subdivision - Determination of limiting GMrequ- Curves - Scantlings of most improtant structural memb - Longitudinal strength - Outfitting Components	bulding contracts and the related technical I their influence on the competitiveness of e total performance of a ship design and th y simple models or formulae. The studen conclusions can be drawn. the different phases of design project, fro enerate bulding specfication relevant inform following topics are adressed: weight	risk are introduced a design. The lec e consecutive proc t shall further lear m the initial design	. The most importa ture focusses on t ess elements. In t n to model comp n phase to a buildi
Skills	 Relevant rules and regulations The student is made familiar with the basic d student shall be able to carry out a concept de the Marine Environment. The lecture deals with of a ship design with respect to fulfillment proc relevant methods to determine and judge uopn 	sign based on a vessel of comparison fulfill the basic design methods to determine the edures of the contract values. Based on the	ng typical contract e fundamantal tec e lecture "Principle	requirements with hnical characterist
Borrough Competence				
Personal Competence	The students learns to prepare technical ma	atters in such a way the he can porcua	de his notantial c	ustomer against
	competitors. The students learns to prepare technical m. competitors.			
Workload in Hours	Independent Study Time 124, Study Time in Leo	cture 56		
	6			
Course achievement	None			
	Written exam			
	180 min			
scale				
Assignment for the Following Curricula	General Engineering Science (German program General Engineering Science (English program,			

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

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

Specialization Process Engineering

Process engineering is the engineering discipline that conducts research into, develops, and realizes material change processes. It deals as a crosssectional 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.

Module M0886: Funda	amentals of Proce	ess Engineering	and Material Engineering		
Courses					
Title			Тур	Hrs/wk	СР
Introduction into Process Engineeri		L0829)	Lecture	2	1
Fundamentals of material engineer			Lecture	2	2
-					
Admission Requirements					
Recommended Previous Knowledge					
Educational Objectives		fully students have rea	ched the following learning results		
Professional Competence	÷ ,	fully, students have rea	ched the following learning results		
Knowledge		e the students have the	ability to:		
···········					
	-		elds on process and bioprocess enginee nt fields in process engineering.	rring,	
Skills	 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, 				
	• explain the most i		, for wastewater and exhaust air treatme gical processes independently with the		
Personal Competence					
Social Competence	The students are able to				
		n groups and document te feedback and handle	them, feedback on their own performance cor	nstructively.	
	Engineering and Bioproc	ess Engineering.	ss of learning by themselves and to de	liberate their lack of k	nowledge in Process
Workload in Hours		34, Study Time in Lecti	ure 56		
Credit points		prm	Description		
Course achievement		/ritten elaboration	Description		
Examination					
Examination duration and					
scale					
Assignment for the	General Engineering Scie	ence (German program,	7 semester): Specialisation Process Eng	gineering: Compulsory	
Following Curricula	General Engineering Scie	ence (German program,	7 semester): Specialisation Bioprocess	Engineering: Compulso	ry
	Bioprocess Engineering:	Core Qualification: Com	pulsory		
			7 semester): Specialisation Process Eng		
			7 semester): Specialisation Bioprocess E	Engineering: Compulsor	У
	Orientierungsstudium: C				
	Process Engineering: Con	e Qualification: Compul	sory		

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

ourse L0830: Fundamentals			
	Lecture		
Hrs/wk			
CP			
Workload in Hours	ndependent 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: Physi	cal Chemistry			
Courses				
Title		Тур	Hrs/wk	СР
Physical Chemistry (L0833)		Lecture	2	2
Physical Chemistry (L0835)		Practical Course	2	1
Module Responsible	Dr. Werner Pauer			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules inorganic chemist	ry, physics for engineers and mathem	atics I-III.	
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	The students are able,			
	-to repeat the basic concepts of physical chemistry			
	-to describe and summarize the underlying concepts	s of mass-, heat- and momentum tran	isfer.	
	- to interpret phase diagrams and affiliate kinetic rat	te laws.		
Skills	The students are able to			
	- conduct (fundamental) thermodynamical, electroch	nemical and kinetic calculations.		
	- assess new applications with respect to environme	ental sustainability.		
	- abstract their knowldege to related issues to condu	uct thermodynamical, electrochemical	and kinetic calculati	ons.
Personal Competence				
Social Competence	The students are able to plan, prepare, conduct and	document experiments according to	scientific guidelines i	n small groups.
	The students are able to reflect their subject-specific	c knowledge orally in a team and to di	scuss it with fellow s	tudents and facult
Autonomy	Students are able to assess their knowldege contin	nuously on their own by exemplified p	practice. Students ar	e able to apply th
	knowldege discretely to plan, prepare and conduct e	experiments.		
Workload in Hours	Independent Study Time 34, Study Time in Lecture	56		
Credit points	3			
Course achievement		Description		
	Yes None Subject theoretical and			
Examination	practical work Written exam			
Examination duration and	180 min			
scale				
	General Engineering Science (German program, 7 se	emester): Specialisation Process Engin	eering: Elective Com	pulsory
	Bioprocess Engineering: Core Qualification: Elective			
-	General Engineering Science (English program, 7 se		eering: Elective Com	oulsory
	Process Engineering: Core Qualification: Elective Con			
Course L0833: Physical Cher	nistry			
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 2	28		
Lecturer	Prof. Alf Mews			
Languago				

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 L0835: Physical Chen	Practical Course
Hrs/wk	
CP	
	Independent Study Time 2, Study Time in Lecture 28 Prof. Alf Mews
Lecturer	
Cycle	
	Wise Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are:
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 (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	programming down to gates. The module includes the Introduction 	following topics:	-	
	 Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division 			
	Basics of computer architecture: Programming		pipelining	
	 Memories: Memory hierarchies, SRAM, DRAM, c Input/output: I/O from the perspective of the CE 		oint conno-ti	husses
Skills	 Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point 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, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers or today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate 			
	the impact that these low abstraction levels have on a	an entire system's performance and to p	ropose feasible o	ptions.
Personal Competence				
-	Students are able to solve similar problems alone or ir	a group and to procent the results acc	ordinaly	
Social Competence		ra group and to present the results act	orunigiy.	
Autonomy	Students are able to acquire new knowledge from spe	cific literature and to associate this know	wledge with othe	r classes.
We while a shire the same	lada and shak Shaka Ting 124. Shaka Ting in Lashara I			
	Independent Study Time 124, Study Time in Lecture 5	00		
Credit points Course achievement	6 Compulsory Bonus Form De	scription		
Course achievement	Yes 10 % Excercises			
Examination	Written exam			
Examination duration and	90 minutes, contents of course and labs			
scale				
Assignment for the	General Engineering Science (German program, 7 sen	nester): Specialisation Computer Science	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7 sen	nester): Specialisation Bioprocess Engine	eering: Compulso	ry
	General Engineering Science (German program, 7 sen	nester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 sen	nester): Specialisation Civil Engineering:	Compulsory	
	General Engineering Science (German program, 7 sen	nester): Specialisation Electrical Enginee	ering: Compulsory	/
	General Engineering Science (German program, 7 sen	nester): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 sen	nester): Specialisation Energy and Enviro	omental Engineer	ring: Compulsory
	General Engineering Science (German program, 7 sen			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering, I	ocus Mechatroni
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
		·		-
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser	7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir	al Engineering, neering, Focus Th	Focus Materials eoretical Mechani
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7	7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi	al Engineering, neering, Focus Th ineering, Focus P	Focus Materials eoretical Mechani roduct Developme
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory	7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi	al Engineering, neering, Focus Th ineering, Focus P	Focus Materials eoretical Mechani roduct Developme
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory	7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical I	al Engineering, neering, Focus Th ineering, Focus P	Focus Materials eoretical Mechani roduct Developme
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory	7 semester): Specialisation Mechanic nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical I	al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc	Focus Materials eoretical Mechani roduct Developme
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem	7 semester): Specialisation Mechanica nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical E	al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc : Compulsory	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem	7 semester): Specialisation Mechanica nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical E ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine	al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc : Compulsory ering: Compulsor	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem	7 semester): Specialisation Mechanica nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical Engine ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine ester): Specialisation Naval Architecture	al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc : Compulsory ering: Compulsory :: Compulsory	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	7 semester): Specialisation Mechanica nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical I ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine ester): Specialisation Naval Architecture ester): Specialisation Civil Engineering:	al Engineering, neering, Focus Th ineering, Focus P Engineering, Focu : Compulsory ering: Compulsory :: Compulsory Compulsory	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	7 semester): Specialisation Mechanica nester): Specialisation Mechanical Engir mester): Specialisation Mechanical Engi semester): Specialisation Mechanical I ester): Specialisation Computer Science ester): Specialisation Bioprocess Engine ester): Specialisation Naval Architecture ester): Specialisation Civil Engineering: ester): Specialisation Electrical Engineer	al Engineering, neering, Focus Th ineering, Focus P Engineering, Focus : Compulsory ering: Compulsory Compulsory ing: Compulsory ing: Compulsory	Focus Materials eoretical Mechani roduct Developm us Energy Syster y

	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
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
5	Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
ā	and Production: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
	Compulsory
	Computational Science and Engineering: Core Qualification: Compulsory
r	Mechatronics: Core Qualification: Compulsory
۲ ا	Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	jineering	
Тур	Lecture	
Hrs/wk		
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE	
Cycle	WiSe	
Content	 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	

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Fluid Mechanics (Lecture	2	4
Fluid Mechanics for Process Engine		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I+II+III			
Kilowieuge	 Technical Mechanics I+II 			
	 Technical Thermodynamics I+II 			
	Working with force balances			
	 Simplification and solving of partial differentia 	l equations		
	Integration			
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	Students are able to:			
	 explain the difference between different types 	s of flow		
	 give an overview for different applications of t 		ess engineering	
	 explain simplifications of the Continuity- and N 			ions
CI-111-	The shuden be and ship be			
SKIIIS	The students are able to			
	 describe and model incompressible flows mat 	hematically		
	 reduce the governing equations of fluid mecha 	anics by simplifications to archive quanti	tative solutions e	.g. by integration
	 notice the dependency between theory and te 			
	 use the learned basics for fluid dynamical app 	lications in fields of process engineering		
Personal Competence				
Social Competence	The students			
	 are capable to gather information from subject 	ct related, professional publications and	relate that inform	nation to the conte
	of the lecture and			
	 able to work together on subject related task 	s in small groups. They are able to pres	sent their results	effectively in Engli
	(e.g. during small group exercises)			
	 are able to work out solutions for exercises by 	themselves, to discuss the solutions or	ally and to presen	t the results.
Autonomy	The students are able to			
	search further literature for each topic and to	1 5		
	 work on their exercises by their own and to ev 	valuate their actual knowledge with the f	eedback.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement		escription		
	Yes 5 % Midterm			
	Written exam			
Examination duration and	3 nours			
scale	General Engineering Science (German program, 7 se	mostor). Spocialization Process Engine	ring: Compulser:	
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se		5 1 5	orv
i chowing curricula	General Engineering Science (German program, 7 se		e .	-
	Bioprocess Engineering: Core Qualification: Compuls			5 ·p ·)
	Energy and Environmental Engineering: Core Qualific	•		
	General Engineering Science (English program, 7 ser	mester): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (English program, 7 ser	nester): Specialisation Bioprocess Engine	eering: Compulso	ry
	General Engineering Science (English program, 7 ser	mester): Specialisation Energy and Envir	omental Engineer	ing: Compulsory
	Technomathematics: Specialisation III. Engineering S			
	Process Engineering: Core Qualification: Compulsory			

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
CP	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. Künchen, Pearson Studium, 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

Course L0092: Fluid Mechani	ics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 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

Courses				
Title		Тур	Hrs/wk	СР
Phase Equilibria Thermodynamics (L0114)	Lecture	2	2
Phase Equilibria Thermodynamics (L0140)	Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (L0142)	Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Mathematics, Physical Chemistry, Ther	modynamics I and II		
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge				
-		f thermodynamics, the students learn the mathema	atical tools to des	cribe thermodyna
	equilibria.			
		are influenced by the mixing of compounds and lea	arn concepts to q	uantitatively desc
	these properties.			
		ow phase equilibria can be described mathematical		-
		olid) coexist in equilibrium. Furthermore the fundame		
		several examples relevant for different kinds of pro	ocesses are show	n and the neces
	knowledge for plotting and inter	preting the equilibria are taught.		
Skills		the damped and the interview for the second second in the		
	 Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibriu state and know how to simplify these equations meaningfully. 			
				la di sua sababa su di d
		ch can be used to determine the properties of the sy	stem in the equili	brium state and i
	are able to solve the resulting m			
		re able to self-reliantly find necessary physico-chemi	cal properties of c	compounds as we
	model parameters in literature s			
		es the students are capable of describing the properti		
		lize phase equilibria graphically and they know how t		
		e students are able to understand fundamental c	oncepts that are	the basis for m
	separation and reaction process	es in chemical engineering.		
Personal Competence				
Social Competence		I groups, to solve the corresponding problems and t	o present them o	raiy to the tutors
	other students			
Autonomy	• The students are able to find nee	cessary information self-reliantly in literature sources	and to judge thei	r quality.
		ents are able to check their learning progress cor	, 5	
	knowledge the students can ade			
		p		
	Independent Study Time 124, Study Tir	me in Lecture 56		
Credit points Course achievement				
Examination				
	120 minutes; theoretical questions and	calculations		
scale	120 minutes, meoretical questions and	- Calculations		
	General Engineering Science (German	program, 7 semester): Specialisation Process Engine	ering: Compulsorv	
Following Curricula		program, 7 semester): Specialisation Bioprocess Engi		
. J	Bioprocess Engineering: Core Qualificat		5	
	General Engineering Science (English n	program, 7 semester): Specialisation Process Enginee	ring: Compulsory	
		program, 7 semester): Specialisation Process Enginee program, 7 semester): Specialisation Bioprocess Engir		ory

se L0114: Phase Equilib	ria Thermodynamics	
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	ndependent 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, 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 L0140: Phase Equilib	ria Thermodynamics
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	 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 The students work on tasks in small groups and present their results in front of all students.
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 Equilib	ria Thermodynamics
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	 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: eaction 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				
		T	Have foods	65
Title Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	CP 4
Signals and Systems (L0433)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
-	Mathematics 1-3			
Knowledge				
	The modul is an introduction to the theory of signals a			
	1-3 is expected. Further experience with spectral tran but not required.	istormations (Fourier series, Fourier tra	ansiorm, Laplace	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached t	the following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals	and linear time-invariant (LTI) systems	using methods of	of signal and syste
	theory. They are able to apply the fundamental trans	formations of continuous-time and disc	crete-time signals	s and systems. The
	can describe and analyse deterministic signals and s	ystems mathematically in both time a	nd image domain	n. In particular, th
	understand the effects in time domain and image do	omain which are caused by the transi	tion of a continu	ous-time signal to
	discrete-time signal.			
Skills	The students are able to describe and analyse determ	-		-
	system theory. They can analyse and design basic			
Barran I Carrante	response, stability, linearity etc They can assess the	impact of LTI systems on the signal pro	perties in time ar	nd frequency doma
Personal Competence	The students can identify calls and the second			
	The students can jointly solve specific problems.	kien from opposite I'm		and that is a
Autonomy	The students are able to acquire relevant informal			ontroi their level
Werkland in Herre	knowledge during the lecture period by solving tutoria		.m.	
	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points				
Course achievement				
Examination			-	
Examination duration and	90 min			
scale	Concerl Engineering Science (Correspondences, 7 corr	aster). Createlization Electrical Engine		
Following Curricula	General Engineering Science (German program, 7 sem General Engineering Science (German program, 7 sem			У
ronowing curricula	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem			orv
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7			
	Compulsory			
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory			
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
	Engineering: Compulsory			
	General Engineering Science (German program, 7	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (German program, 7 sem	nester): Specialisation Mechanical Engir	ieering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Computer Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 seme	aster): Specialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 sene			
	General Engineering Science (English program, 7 seme			
	General Engineering Science (English program, 7 seme			rv
	General Engineering Science (English program, 7 seme			-
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	I Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical I	Engineering, Foc	us Energy Systen
	Compulsory			
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syster
	Engineering: Compulsory			
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engine	eering, Focus Mat	terials in Engineeri
	Sciences: Compulsory			
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	l Engineering, I	Focus Mechatroni
	Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechani
	Engineering, Compulsory			
	Engineering: Compulsory			
	Computational Science and Engineering: Core Qualifica Mechatronics: Core Qualification: Compulsory	ation: Compulsory		

Course L0432: Signals and S	ystems
Тур	Lecture
Hrs/wk	3
СР	4
	Independent Study Time 78, Study Time in Lecture 42
Language Cycle	
Content	
	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.
L	1

Course L0433: Signals and S	ourse 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		Тур	Hrs/wk	СР
Bioprocess Engineering - Fundame		Lecture	2 (1e) 2	3 1
Bioprocess Engineering- Fundamer Bioprocess Engineering - Fundame		Recitation Section (larg Practical Course	2 2	2
Module Responsible			-	-
Admission Requirements				
Recommended Previous		"fundamentals for process ongineering"		
Knowledge		: Initialiteitais for process engineering		
0	After taking part successfully, students have	ve reached the following learning results		
Professional Competence		vereached the following learning results		
	enzymes and microorganisms, as well a rheology can be named and mass trans fundamental bioprocess management, ste	ncepts of bioprocess engineering. They are as to differentiate different types of inhibi port processes in bioreactors can be expla rilization technology and downstream proces	tion. The parameters o ained. The students ar	of stoichiometry a
SkillS	 predict qualitatively the influence fermentation process analyze bioprocesses on basis of sto distinguish between scale-up criteri to compare them as well as to apply propose solutions to complicated bio to explore new knowledge resources identify scientific problems with complementation 	c, students should be able to es for growth and substrate-uptake and to ca of energy generation, regeneration of redo oichiometry and to set up / solve metabolic f ia for different bioreactors and bioprocesses y them to current biotechnical problem otechnological problems and to deduce the o s and to apply the newly gained contents increte industrial use and to formulate solutio edures as well as results in a scientific mann	ox equivalents and gro lux equations (anaerobic, aerobic as corresponding models ns.	wth inhibition on t
	After completion of this module participan take position to their own opinions and inc	nts should be able to debate technical quest crease their capacity for teamwork in enginer nts will be able to solve a technical problem plenum.	ering and scientific envi	ronments.
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
	<u> -</u>			
Credit points Course achievement	Compulsory Bonus Form	Description		
Credit points	CompulsoryBonusFormYes5 %Subjecttheoretic			
Credit points				
Credit points Course achievement	Yes 5 % Subject theoretic			
Credit points Course achievement Examination	Yes 5 % Subject theoretic practical work Written exam 90 min			
Credit points Course achievement Examination Examination duration and	Yes 5 % Subject theoretic practical work Written exam 90 min		ngineering: Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German prog General Engineering Science (German prog	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German pro- General Engineering Science (German pro- Bioprocess Engineering: Core Qualification	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory	s Engineering: Compuls	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification General Engineering Science (English prog	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory gram, 7 semester): Specialisation Process En	s Engineering: Compulsory	ory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German programmering Science (German programmering Science (German programmering Science (German programmering Science (English programering Science (English programmering Science (English programerin	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess	s Engineering: Compulso gineering: Compulsory Engineering: Compulso	ory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German programmedia Engineering Science (German programmedia Engineering: Core Qualification General Engineering Science (English programmedical Engineering Science (English programmedical Engineering: Specialisation Articles)	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess ificial Organs and Regenerative Medicine: Co	s Engineering: Compulso gineering: Compulsory Engineering: Compulso ompulsory	ory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Art Biomedical Engineering: Specialisation Imp	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess ificial Organs and Regenerative Medicine: Co plants and Endoprostheses: Elective Compuls	s Engineering: Compulsory gineering: Compulsory Engineering: Compulso pmpulsory sory	ory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Art Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Meterical	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess ificial Organs and Regenerative Medicine: Co plants and Endoprostheses: Elective Compuls dical Technology and Control Theory: Electiv	s Engineering: Compulsory gineering: Compulsory Engineering: Compulso pompulsory sory re Compulsory	ory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretic practical work Written exam 90 min General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core Qualification General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Art Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Meterical	gram, 7 semester): Specialisation Process Er gram, 7 semester): Specialisation Bioprocess I: Compulsory gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess ificial Organs and Regenerative Medicine: Co plants and Endoprostheses: Elective Compuls dical Technology and Control Theory: Electiv nagement and Business Administration: Electiv	s Engineering: Compulsory gineering: Compulsory Engineering: Compulso pompulsory sory re Compulsory	ory

Course L0841: Bioprocess En	gineering - Fundamentals
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng
Language	DE
Cycle	SoSe
Content	 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)
	 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: Bioprocess En	Course L0842: Bioprocess Engineering- Fundamentals		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	1		
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Prof. Andreas Liese, Prof. An-Ping Zeng		
Language	DE		
Cycle	SoSe		
Content	1. Introduction (Prof. Liese, Prof. Zeng)		
	2. Enzymatic kinetics (Prof. Liese)		
	3. Stoichiometry I + II (Prof. Liese)		
	4. Microbial Kinetics I+II (Prof. Zeng)		
	5. Rheology (Prof. Liese)		
	6. Mass transfer in bioprocess (Prof. Zeng)		
	7. Continuous culture (Chemostat) (Prof. Zeng)		
	8. Sterilisation (Prof. Zeng)		
	9. Downstream processing (Prof. Liese)		
	10. Repetition (Reserve) (Prof. Liese, Prof. Zeng)		
Literature	siehe Vorlesung		

Course L0843: Bioprocess En	ngineering - 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

2					
Courses					
Title		Тур	Hrs/wk	СР	
Power Industry (L0316)		Lecture	1 2	1 2	
Energy Systems and Energy Indust Renewable Energy (L0313)	ry (L0315)	Lecture Lecture	2	2	
Renewable Energy (L1434)		Recitation Section (small)	1	1	
	Prof. Martin Kaltschmitt				
Admission Requirements					
Recommended Previous	none				
Knowledge	lione				
Educational Objectives	After taking part successfully, students have reach	hed the following learning results			
Professional Competence	Arter taking part successivily, students have reach	ied the following learning results			
-	With completion of this module, the students ca	n provide an evention of characteristics	of operav systems	and their econor	
Knowledge	efficiency. They can explain the issues occurring in				
	distribution and power trading wih regard to s				
	applicable to many energy systems in general, e	•			
	the students can explain the environmental benef			s them. Furthering	
	the students can explain the environmental benef	its nom the use of such systems.			
Skills	Students are able to apply methodologies for det	ailed determination of energy demand or	r energy productior	oduction for various types of	
	energy systems. Furthermore, they can evaluate				
	under certain given conditions. Therefore, the	y can choose the necessary subject-s	pecific calculation	rules, also for	
	standardized solutions of a problem.				
	-				
	The students are able to explain questions and possible approaches to its processing from the field of renewable energies			wable energies or	
	and to put them them into the right context.				
Personal Competence					
Social Competence	The students are able to analyze suitable techn	ical alternatives and to assess them wit	h technical, econo	mical and ecolog	
	criteria under sustainability aspects. This allows th				
Autonomy		quire the particular knowledge about the	e subject area and	transform it to r	
	questions.				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	3 hours written exam				
scale					
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Energy and Env	viromental Enginee	ring: Compulsory	
Following Curricula	General Engineering Science (German program,	, 7 semester): Specialisation Mechanica	l Engineering, Foo	us Energy System	
	Elective Compulsory				
	General Engineering Science (German program, 7	semester): Specialisation Process Engine	ering: Elective Con	npulsory	
	Energy and Environmental Engineering: Core Qua	lification: Compulsory			
	General Engineering Science (English program, 7	semester): Specialisation Energy and Env	iromental Engineer	ing: Compulsory	
	General Engineering Science (English program,	7 semester): Specialisation Mechanica	l Engineering, Foc	us Energy Syste	
	Elective Compulsory				
	General Engineering Science (English program, 7	compostor): Specialization Process Engine	ring, Elective Com		
	Scherdi Engineering Science (Engilsin program, 7.	semester). Specialisation riocess Enginee	ening. Elective Com	puisory	

Course L0316: Power Industr	γ
Тур	Lecture
Hrs/wk	1
CP	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 System	ourse L0315: Energy Systems and Energy Industry		
Тур	Lecture		
Hrs/wk	2		
CP	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: Renewable Er	Iergy
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

ourse L1434: Renewable Energy		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt	
Language	DE/EN	
Cycle	SoSe	
Content	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		Tun	Hrs/wk	СР
Heat and Mass Transfer (L0101)		Typ Lecture	2	2
Heat and Mass Transfer (L0102)		Recitation Section (small)	1	2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
	Prof. Irina Smirnova		_	
•				
Admission Requirements				
Recommended Previous	Basic knowledge: Technical Thermodynamic	CS		
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge				
	 heat exchanger, chemical reactors). They are capable of distinguish and or transfer and thermal radiation. The students have the ability to exqualitative and quantitative by using 	ng qualitative and determining quantitative hea characterize different kinds of heat transfer me xplain the physical basis for mass transfer in suitable mass transfer theories. between heat- and mass transfer and to describe	chanisms namely h detail and to de	neat conduction, he
Skills	 and to balance the corresponding end They are capable to solve specific he and to calculate the corresponding he Using dimensionless quantities, the s They are able to distinguish between for the description and design of appare In this context, the students are capa application considering their advanta In addition, they can calculate both, s The students are capable to conn 	eat transfer problems (e.g. heated chemical re-	actors, temperatur cesses or apparatu s transfer. They can mn). heat and mass exi procedural apparat with knowlegde	e alteration in fluid s. n use this knowled changer for a speci cus. of other courses
Personal Competence Social Competence	 The students are capable to work on manner to tutors and other students. 	subject-specific challenges in teams and to pr	esent the results o	orally in a reasonal
Autonomy	• They are able to prove their level of	luate necessary information from suitable sourd of knowledge during the course with accompa on this basis they can control their learning pro	inying procedure	continuously (click
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
	Written exam			
Examination		ulations		
Examination	120 minutes: theoretical questions and calc			
Examination Examination duration and	120 minutes; theoretical questions and calc			
Examination Examination duration and scale		rom 7 competer), Createliantics Process 5	oring, Comercia-	
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr	ram, 7 semester): Specialisation Process Engine		
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr	ram, 7 semester): Specialisation Bioprocess Eng	ineering: Compulse	ory
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env	ineering: Compulse viromental Enginee	ory
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr	ram, 7 semester): Specialisation Bioprocess Eng	ineering: Compulse viromental Enginee	ory
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env ram, 7 semester): Specialisation Green Technolo	ineering: Compulse viromental Enginee	ory
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env ram, 7 semester): Specialisation Green Technolo Compulsory	ineering: Compulse viromental Enginee	ory
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: Energy and Environmental Engineering: Cor	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env ram, 7 semester): Specialisation Green Technolo Compulsory	ineering: Compulso viromental Enginee ogies: Compulsory	ory ring: Compulsory
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: Energy and Environmental Engineering: Cor General Engineering Science (English progr	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env ram, 7 semester): Specialisation Green Technolo Compulsory re Qualification: Compulsory am, 7 semester): Specialisation Bioprocess Engi	ineering: Compulso viromental Enginee ogies: Compulsory neering: Compulso	ory ring: Compulsory ry
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: Energy and Environmental Engineering: Cor General Engineering Science (English progr General Engineering Science (English progr	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env ram, 7 semester): Specialisation Green Technolo Compulsory re Qualification: Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Energy and Env	ineering: Compulso viromental Enginee ogies: Compulsory neering: Compulso iromental Engineer	ory ring: Compulsory ry
Examination Examination duration and scale Assignment for the	General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: Energy and Environmental Engineering: Cor General Engineering Science (English progr General Engineering Science (English progr	ram, 7 semester): Specialisation Bioprocess Eng ram, 7 semester): Specialisation Energy and Env ram, 7 semester): Specialisation Green Technolo Compulsory e Qualification: Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Energy and Env am, 7 semester): Specialisation Process Engineer	ineering: Compulso viromental Enginee ogies: Compulsory neering: Compulso iromental Engineer	ory ring: Compulsory ry

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01		Lecture	2	2
Thermal Separation Processes (L01		Recitation Section (small)	2	2
Thermal Separation Processes (L01 Separation Processes (L1159)	41)	Recitation Section (large) Practical Course	1 1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamic	cs III		
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	adsorption The students develop an understandin energy demand of a process, the possit 	scribe different types of separation processes g for the course of concentration during a sepa pilities of energy saving, and the selection of se g methods for separation processes and devices	aration process, t paration systems	the estimation of t
Skills Personal Competence Social Competence	 close the associated energy and materi The students can use different graphi theoretical stages required They can select and design a basic ty disadvantages of the process The students are capable to obtain ind tables) They can calculate continuous and disc The students are able to prove their the colloquium. The students are capable of linking their gaine technical problems. Other lectures such as the 	ical methods for the designing of a separatio ype of thermal separation process for a given lependently the needed material properties fro ontinuous processes eoretical knowledge in the experimental lab wor leoretical background and the content of the ex- ed knowledge with the content of other lectures ermodynamics, fluid mechanics and chemical er	n process and d case based on m appropriate so k. cperimental work and use it togeth ngineering.	efine the amount the advantages a surces (diagrams a with the teachers her for the solution
Sucial Competence	• The students are able to carry out pra	ments in small groups and present the combine actical lab work in small groups and organize a sults and to document them scientifically in a re	functional divis	
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement	None			
Examination				
	120 minutes; theoretical questions and calcula	ations		
scale	Concert Frankright Children (C			
		m, 7 semester): Specialisation Process Engineer		
Following Curricula		n, 7 semester): Specialisation Bioprocess Engin		
		n, 7 semester): Specialisation Energy and Envir	omental Enginee	ring: compulsory
	Bioprocess Engineering: Core Qualification: Co Energy and Environmental Engineering: Core			
	Energy and Environmental Engineering: Core			
	General Engineering Science (English program	1 / semester). Specialisation Bioprocess Engine	ering (amoulea	rv
	General Engineering Science (English program General Engineering Science (English program			
	General Engineering Science (English program	 J semester): Specialisation Bioprocess Engine J semester): Specialisation Energy and Enviro J semester): Specialisation Process Engineeri 	mental Engineer	

e L0118: Thermal Sepa	Lecture
Hrs/wk	
CP	
-	
	Independent Study Time 32, Study Time in Lecture 28
	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 separati 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 Yo 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Course L0119: Thermal Sepa	ration Processes
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 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	 The students work on tasks in small groups and present their results in front of all students. 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 separatio 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

Course L0141: Thermal Sepa	ration Processes
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 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

Course L1159: Separation Pr	ocesses
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
Content	
	takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.
	Topics of the practical course:
	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 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

Module M0892: Chem	ical Reaction E	ngineering				
Courses						
Title				Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fu	ndamentals) (L0204)			Lecture	2	2
Chemical Reaction Engineering (Fu				Recitation Section (large)	2	2
Experimental Course Chemical Eng	ineering (Fundamentals)	(L0221)		Practical Course	2	2
Module Responsible	Prof. Raimund Horn					
Admission Requirements	None					
Recommended Previous	Contents of the previ	ous modules mathemat	ics I-III, physical c	hemistry, technical thermody	namics I+II as w	ell as computationa
Knowledge	methods for engineers	S.				
Educational Objectives	After taking part succ	essfully, students have	reached the followi	ng learning results		
Professional Competence						
Knowledge	The students are able	e to explain basic conce	pts of chemical rea	action engineering. They are	able to point out	differences betweer
	thermodynamical and	d kinetical processes. T	he students have	a strong ability to outline pa	arts of isotherma	and non-isotherma
	ideal reactors and to o	describe their properties	5.			
Skills	After successful comp	letion of the module, st	udents are able to:			
	- apply different comr	utational methods to di	mension isotherma	al and non-isothermal ideal re	actors	
	- apply difference of the				actors,	
	- determine and comp	oute stable operation po	ints for these react	cors ,		
	conduct experiment	s on a lab scalo nilot nla	nts and document	these according to scientific	quidolinos	
	- conduct experiments	s on a lab-scale phot pla	into and document	these according to scientific	guidennes.	
Personal Competence						
Social Competence	After successful comp	pletition of the lab-cours	e the students ha	ve a strong ability to organiz	e themselfes in s	mall groups to solve
	issues in chemical re	action engineering. The	e students can dis	cuss their subject related kr	owledge among	each other and with
	their teachers.					
Autonomy	The students are al	ole to obtain further i	nformation and a	ssess their relevance auto	nomously. Studer	nts can apply their
	knowldege discretely	to plan, prepare and co	nduct experiments			
Workload in Hours	Independent Study Tir	me 96, Study Time in Le	ecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Subject theoretical	and			
		practical work				
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	General Engineering S	Science (German progra	m, 7 semester): Sp	ecialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering S	Science (German progra	m, 7 semester): Sp	ecialisation Bioprocess Engin	eering: Compulso	ory
	Bioprocess Engineerin	ng: Core Qualification: C	ompulsory			
	Bioprocess Engineerin	ng: Core Qualification: Co	ompulsory			
	General Engineering S	Science (English program	n, 7 semester): Spe	ecialisation Bioprocess Engine	ering: Compulso	гy
	General Engineering S	Science (English program	n, 7 semester): Spe	ecialisation Process Engineeri	ng: Compulsory	
	Process Engineering:	Core Qualification: Com	pulsory			
	Process Engineering:	Core Qualification: Com	pulsory			

Course L0204: Chemical Read	ction Engineering (Fundamentals)
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn
Language	DE
Cycle	WiSe
Content	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? 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)

	mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius- equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre- equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics) Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous
	and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)
	Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
Literature	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
	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	

Course L0244: Chemical Rea	ction Engineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE
Cycle	WiSe
Content	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

	skript Frerich Keil
Literature	lecture notes Raimund Horn
	flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical- interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors) non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
	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
	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 equivations, integration factor, numerical integration of complex vinetics).
	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)

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

Courses						
Title			Тур		Hrs/wk	СР
Practical Exercise Environmental Te	echnology (L1387)		Practical Cou	irse	1	1
Environmental Technologie (L0326)		Lecture		2	2
Module Responsible	Prof. Martin Kaltschm	nitt				
Admission Requirements	None					
Recommended Previous	Fundamentals of inor	rganic/organic chemist	ry and biology			
Knowledge						
Educational Objectives	After taking part succ	cessfully, students hav	e reached the following learning re	esults		
Professional Competence						
Knowledge	With the completion of	of this modul the stud	ents obtain profound knowledge of	f environmental tecl	hnology. They	are able to describ
	the behaviour of cher	micals in the environr	ment. Students can give an overvi	ew of scientific disc	iplines involve	ed. They can expla
	terms and allocate the	nem to related method	s.			
Chille	Chudonte ere oble te		menoperate and militarian man	anna far an úrann	antal nyahlam	
581115			management and mitigation means assess the potential of pollutant			-
	-		vironmental Technology contribute	-		
		inons in front of and a		25 to sustainable de	evelopment, a	nu they can prese
	and defend these opin		gainst the group.			
Personal Competence						
Social Competence	The students are able	e to discuss the variou	s technical and scientific tasks, bo	th subject-specific a	and multidiscip	linary. They are al
	to develop different a	approaches to the task	as a group as well as to discuss th	neir theoretical or pr	ractical impler	nentation.
Autonom	Chudonte con indones		a abaut of the subject convire the		a and tranfar	it to now problem.
Autonomy	Students can indepen	identity exploit sources	s about of the subject, acquire the	particular knowledg	je and tranier	it to new problems
Workload in Hours	Independent Study Ti	ime 48, Study Time in	Lecture 42			
Credit points	3					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Subject theoretics	al and			
		practical work				
	Written exam					
Examination duration and	1 hour					
scale						
	General Engineering S		ram, 7 semester): Specialisation E		-	
-				ioprocess Engineeri	ing: Elective C	
Assignment for the Following Curricula	General Engineering S					
-	General Engineering S	Science (German prog	ram, 7 semester): Specialisation P	rocess Engineering:	Elective Com	pulsory
-	General Engineering S Bioprocess Engineerin	Science (German prog ing: Core Qualification:	ram, 7 semester): Specialisation P Elective Compulsory	rocess Engineering:	Elective Com	pulsory
-	General Engineering S Bioprocess Engineerin Energy and Environm	Science (German prog ing: Core Qualification: nental Engineering: Co	ram, 7 semester): Specialisation P Elective Compulsory re Qualification: Compulsory			
-	General Engineering S Bioprocess Engineerir Energy and Environm General Engineering S	Science (German pro- ing: Core Qualification: nental Engineering: Co Science (English progr	ram, 7 semester): Specialisation P Elective Compulsory re Qualification: Compulsory ram, 7 semester): Specialisation Bi	ioprocess Engineerir	ng: Elective Co	ompulsory
-	General Engineering S Bioprocess Engineerin Energy and Environm General Engineering S General Engineering S	Science (German prog ing: Core Qualification: nental Engineering: Co Science (English progr Science (English progr	ram, 7 semester): Specialisation P Elective Compulsory re Qualification: Compulsory ram, 7 semester): Specialisation Bi ram, 7 semester): Specialisation Er	ioprocess Engineerir nergy and Envirome	ng: Elective Co ntal Engineeri	ompulsory ng: Compulsory
-	General Engineering S Bioprocess Engineerin Energy and Environm General Engineering S General Engineering S General Engineering S	Science (German prog ing: Core Qualification: nental Engineering: Co Science (English progr Science (English progr	ram, 7 semester): Specialisation P Elective Compulsory re Qualification: Compulsory ram, 7 semester): Specialisation Bi ram, 7 semester): Specialisation Pr ram, 7 semester): Specialisation Pr	ioprocess Engineerir nergy and Envirome	ng: Elective Co ntal Engineeri	ompulsory ng: Compulsory

Course L1387: Practical Exer	rcise Environmental Technology
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE
Cycle	SoSe
Content	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

E.

Course L0326: Environmenta	l Technologie
Тур	Lecture
Hrs/wk	2
CP	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
Literature	Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN)

Courses Title Practical Course Measurement Tech							
Practical Course Measurement Tech							
			Тур	Hrs/wk	СР		
	nology (L2270)		Practical Course	2	2		
Measurement Technology (L2268)			Lecture	2	2		
Physical Fundamentals of Measurem	nent Technology (L2269	hent Technology (L2269) Lecture 2 2					
Module Responsible	Prof. Alexander Penn						
Admission Requirements	None						
Recommended Previous	Technical interest, lo	gical skills, integral	- and differential calculus, basic physical con	cepts such as tempera	ature, mass, velocity		
Knowledge	etc						
Educational Objectives	After taking part succ	essfully, students h	nave reached the following learning results				
Professional Competence							
	 Physical basics: kinematics and dynamics (theory of motion), rotation of rigid bodies, energy and momentum, electric magnetism, basics of hydrodynamics, temperature and heat, ideal gas. 				omentum, electricity		
	Metrology: SI units, measurement and measurement uncertainty, basics of sensor technology, physical principles, temperatu measurement, pressure measurement, level measurement, flow measurement. Usage of Matlab scripts. Practical course: Pressure drop in piping, calorimetry, image data acquisition, flow measurement, concentration measurement a						
	mass transfer, capaci	itive measurements	s of solid concentrations, spectroscopy, error c	alculation, chromatogra	aphy		
	Literature research, categorisation of thematical topics, analysis of an experimental test stand, preparation of test protocol, firm programming with Matlab, use of relevant laboratory measurement technology, preparation of a test protocol, execution of calculations.						
Personal Competence							
	-	in groups, consult	actical training and learning groups, assessm tation with persons responsible for teachin		-		
-	Time management of the workload, independent development of the thematic basics, personal responsibility for the provision of protective equipment and work clothing, practice of presentation in front of a group, active participation in the lectures formulation of enquiries/detailed questions by using clicker.						
Workload in Hours	Independent Study Ti	ime 96, Study Time	in Lecture 84				
Credit points	6						
course achievement	Compulsory Bonus Yes 5 %	Form Attestation	Description Testate für Messtechnikpraktikum				
Examination	Written exam						
Examination duration and	120 min						
scale							
Assignment for the	General Engineering	Science (German pr	rogram, 7 semester): Specialisation Process Er	ngineering: Compulsory			
			rogram, 7 semester): Specialisation Green Tec				
-	Bioprocess Engineeri			,			
			ogram, 7 semester): Specialisation Process En	gineering: Compulsory			
			: Elective Compulsory				
	Process Engineering:						

Course L2270: Practical Course	rse Measurement Technology
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Alexander Penn
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.

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

Тур
Hrs/wk
CP
Workload in Hours
Lecturer
Language
Cycle
Content
Literature

Course L2269: Physical Fund	ourse L2269: Physical Fundamentals of Measurement Technology			
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			-	Гур	Hrs/wk	СР
Process and Plant Engineering I (LO)95)			Lecture	2	2
Process and Plant Engineering I (L0096)			F	Recitation Section (large)	1	2
Process and Plant Engineering I (L1	214)		F	Recitation Section (small)	1	2
Module Responsible	Prof. Mirko Skiborows	iki				
Admission Requirements	None					
Recommended Previous	unit operation of ther	mal an dmechanical sep	aration processes			
Knowledge	chemical reactor eingineering					
Educational Objectives	After taking part succ	essfully, students have	reached the following	a learning results		
Professional Competence		····), -····		,		
	students can:					
	classify and formulate	e blobal balance equatio	ns of chemical proce	sses		
	specify linear compo	nent equations of comple	ex chemical processe	25		
		sion and data reconcilliat	tion problems			
	explain pfd-diagrams					
Skills	- formulation of mass and energy balance equations and estimation of product streams					
	- formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models					
	- solution of data reco		ai plants using intear	component bulance model	3	
	- conduction of proce					
		n of processes and the e	stimation of producti	on costs		
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study T	ime 124, Study Time in I	_ecture 56			
Credit points	6					
Course achievement	CompulsoryBonusYes10 %	Form Subject theoretical practical work	Description and			
Examination	Written exam	practical front				
Examination duration and		es and books				
scale	General Engineering	Science (German progra	m 7 comestor): Soo	cialisation Process Engineer	ing: Compulsory	
-				cialisation Bioprocess Engineer		irv
i onowing curricula	5 5			Specialisation Energy and	5 1	5
	Compulsory	selence (Serman proj	gram, / Semestel).	specialisation Energy and		
		ng: Core Qualification: C	ompulsory			
				ialisation Bioprocess Engine	ering: Compulso	v
	General Engineering			Specialisation Energy and		
	Compulsory	Science (English are	n 7 comoctor). Cr	indication Process Fasters	na Compulsor	
		Core Qualification: Com		ialisation Process Engineeri	ng. compulsory	

Course L0095: Process and P	Plant Engineering I		
Тур	cture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Mirko Skiborowski		
Language	DE		
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
	3. Process Synthesis Decision levels
	Experimental process development
	Reactor synthesis
	Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams)
	4. Process safety
	5. Cost estimation of production plants
	Production costs, capital costs, economic evaluation
Literature	
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	M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916
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	G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
	D. Hairston, Chemical Engineering, October 2001, S. 31-37
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	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
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Course L0096: Process and P	Course 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	f. Mirko Skiborowski, Dr. Thomas Waluga			
Language	DE			
Cycle	SoSe			
Content	ee interlocking course			
Literature	See interlocking course			

Course L1214: Process and F	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	

Module M0670: Partic	le Techr	nology	and Solids Proce	ss Engineeri	ng		
Courses							
Title					Тур	Hrs/wk	СР
Particle Technology I (L0434)					Lecture	2	3
Particle Technology I (L0435)					Recitation Section (small)	1	1
Particle Technology I (L0440)					Practical Course	2	2
Module Responsible	Prof. Stefan	Heinrich					
Admission Requirements	None						
Recommended Previous	keine						
Knowledge							
Educational Objectives	After taking	g part succ	essfully, students have r	eached the followi	ng learning results		
Professional Competence							
Knowledge	After succe	ssful comp	pletion of the module stu	dents are able to			
			ain processes and unit-				
	• chara	acterize pa	articles, particle distribut	ions and to discuss	s their bulk properties		
Skills	Students ar	e able to					
	• choo	se and de	sign apparatuses and pro	ocesses for solids p	processing according to the d	esired solids pror	perties of the produc
	 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 						
			r work scientifically.				
			,				
Personal Competence							
Social Competence	The studen	its are ab	le to discuss scientific to	opics orally with o	other students or scientific p	personal and to o	develop solutions fo
	technical-so	cientific iss	sues in a group.				
Autonomy	Students ar	e able to a	analyze and solve question	ons regarding solid	particles independently.		
Workload in Hours	Independer	nt Study Ti	me 110, Study Time in L	ecture 70			
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Written elaboration	sechs Bericht	te (pro Versuch ein Bericht) à	5-10 Seiten	
Examination	Written exa	im					
Examination duration and	90 minutes						
scale							
Assignment for the	General Eng	gineering !	Science (German prograr	n, 7 semester): Sp	ecialisation Process Engineer	ring: Compulsory	
					ecialisation Bioprocess Engin		bry
-					ecialisation Energy and Envir	÷ .	-
			ng: Core Qualification: Co			-	
		-	ental Engineering: Core (pulsory		
					cialisation Bioprocess Engine	eering: Compulso	ry
					cialisation Energy and Enviro		-
					cialisation Process Engineeri	-	,
					· · · · · · · · · · · · · · · · · · ·	5	

Course L0434: Particle Techr	nology I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE
Cycle	SoSe
Content	 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 Tech	Course L0435: Particle Technology I	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Stefan Heinrich	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0440: Particle Tech	nology 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		Тур	Hrs/wk	СР
Informatics for Process Engineers (L0836)	Lecture	2	2
Informatics for Process Engineers (L0837)	Recitation Section (small)	2	2
Numeric and Matlab (L0125)		Practical Course	2	2
Module Responsible	Dr. Marcus Venzke			
Admission Requirements	None			
Recommended Previous	Basic knowledge in using MS Windows.			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students can describe procedural and obje	ect-oriented concepts.		
Skille	Students are capable of object oriented r	rogramming in the programing language Java and	l of colving math	omatic questions h
SKIIIS	using Matlab.	rogramming in the programmy language java and	I OF SOLVING INALI	ematic questions
	using Hadab.			
	Students are capable of developing conce	ots (simple algorithms) to solve technical questions		
_				
Personal Competence				
Social Competence	Students are able to work out solutions to	gether in small groups.		
Autonomy	Students are able to assess acquired skills	by applying it in practice.		
Autonomy		·····		
-	Independent Study Time 96, Study Time ir			
-				
Workload in Hours				
Workload in Hours Credit points	6 None			
Workload in Hours Credit points Course achievement	6 None Written exam			
Workload in Hours Credit points Course achievement Examination	6 None Written exam			
Workload in Hours Credit points Course achievement Examination Examination duration and scale	6 None Written exam 90 min	Lecture 84	Enviromental F	ngineerina: Electiv
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 90 min General Engineering Science (German p		Enviromental E	ngineering: Electiv
Workload in Hours Credit points Course achievement Examination Examination duration and scale	6 None Written exam 90 min General Engineering Science (German p Compulsory	rogram, 7 semester): Specialisation Energy and		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 90 min General Engineering Science (German p Compulsory General Engineering Science (German pro	rogram, 7 semester): Specialisation Energy and		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 90 min General Engineering Science (German p Compulsory General Engineering Science (German pro Bioprocess Engineering: Core Qualification	rogram, 7 semester): Specialisation Energy and gram, 7 semester): Specialisation Process Engineer : Compulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 90 min General Engineering Science (German pr Compulsory General Engineering Science (German pro Bioprocess Engineering: Core Qualification Energy and Environmental Engineering: Co	rogram, 7 semester): Specialisation Energy and gram, 7 semester): Specialisation Process Engineer : Compulsory ore Qualification: Compulsory	ing: Elective Com	ipulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 90 min General Engineering Science (German p Compulsory General Engineering Science (German pro Bioprocess Engineering: Core Qualification Energy and Environmental Engineering: Co General Engineering Science (English p	rogram, 7 semester): Specialisation Energy and gram, 7 semester): Specialisation Process Engineer : Compulsory	ing: Elective Com	pulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 90 min General Engineering Science (German p Compulsory General Engineering Science (German pro Bioprocess Engineering: Core Qualification Energy and Environmental Engineering: Co General Engineering Science (English p Compulsory	rogram, 7 semester): Specialisation Energy and gram, 7 semester): Specialisation Process Engineer : Compulsory ore Qualification: Compulsory	ing: Elective Com Enviromental E	ngineering: Electiv

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	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
	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachuse 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

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

Course L0125: Numeric and	Matlab
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 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): Moler, C., Numerical Computing with MATLAB, SIAM, 2004 The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Courses				
Title		Turn	Hre /ul	СР
Environmental Assessment (L0860)		Typ Lecture	Hrs/wk 2	2
Environmental Assessment (L1054)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
-	None			
-	Fundamentals of inorganic/organic chemistry and	1 biology		
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	With the completion of this module the stude environmental problems which might occur from about the methodological diversity and are comp impacts. Besides the students are able to estim- difficulties with their measurement	n production processes, projects or constru- betent in dealing with different methods an	ction measures. d instruments to	They have knowled assess environmen
Skills	difficulties with their measurement. The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby the can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carr out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database EcoInven After finishing the course the students have the competence to critically judge research results or other publications o environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various tech to develop jointly different solutions and to dis topics, the students receive insights into the mu Their sensitivity and consciousness towards the social responsibilities in their role as engineers.	ccuss their theoretical or practical implem Iti-layered issues of the environment prote	entation. Due to ction and the cor	the selected lecture acept of sustainabilities
Autonomy	The students learn to research, process and present a scientific topic independently. They are able to carry out independer scientific work. They can solve an environmental problem in a business context and are able to judge results of other publications			
Workload in Hours	Independent Study Time 48, Study Time in Lectu	re 42		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	1 hour written exam			
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Energy and Env	romental Engine	ering: Compulsory
Following Curricula	General Engineering Science (German program,	7 semester): Specialisation Bioprocess Engi	neering: Elective	Compulsory
	General Engineering Science (German program,		ring: Elective Co	mpulsory
	Bioprocess Engineering: Core Qualification: Elect			
	Energy and Environmental Engineering: Core Qu		and an et al.	2
	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Engir	eering: Elective (Compulsory

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

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

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

Thesis	
Module M-001: Bache	lor Thesis
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	
	 According to General Regulations §21 (1): At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
	At least 120 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge	After taking part successfully, students have reached the following learning results
Professional Competence	After taking part successfully, students have reached the following learning results
Knowledge Skills	 The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their cours 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 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. 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 of technical issues, and develop solutions.
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	 The students can take up a critical position on the findings of their own research work from a specialized perspective. Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably ar in a structured way. The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they can uphold their own assessments and viewpoints convincingly. The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within 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	12
Course achievement	None
	Thesis
Examination duration and	According to General Regulations
scale Assignment for the	General Engineering Science (German program): Thesis: Compulsory
Following Curricula	General Engineering Science (German program): Thesis: Compulsory General Engineering Science (German program, 7 semester): Thesis: Compulsory
	Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: 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): Thesis: Compulsory General Engineering Science (English program): Thesis: Compulsory General Engineering Science (English program, 7 semester): Thesis: Compulsory Green Technologies: Energy, Water, Climate: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory Technomathematics: Thesis: Compulsory Teilstudiengang Lehramt Elektrotechnik:.Informationstechnik: Thesis: Compulsory Process Engineering: Thesis: Compulsory