

Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2019 Updated: 31st May 2023

Table of Contents

Table of Conte	nts	2
Program descr	iption	5
Core Qualificat		6
	Non-technical Courses for Bachelors	6
	Electrical Engineering I: Direct Current Networks and Electromagnetic Fields	8
	Mechanics I (Statics)	9
Module M0850:		11
Module M1315: Module M0687:	Physics for Engineers (AIW)	14 16
	Programming in C	10
	Electrical Engineering II: Alternating Current Networks and Basic Devices	21
	Fundamentals of Mechanical Engineering Design	24
Module M0696:	Mechanics II: Mechanics of Materials	26
Module M0671:	Technical Thermodynamics I	28
Module M0851:		30
	Technical Thermodynamics II	33
	Mechanics III (Dynamics)	35
	Mathematics III Signals and Systems	37 40
	Introduction to Control Systems	40
	Foundations of Management	46
	Advanced Internship AIW/ ES	49
	Civil Engineering	51
	Principles of Building Materials and Building Physics	51
Module M0740:	Structural Analysis I	53
	Building Materials and Building Chemistry	55
	Reinforced Concrete Structures I	56
In	Structural Analysis II	58
Module M0706:		60
	Steel Structures I Applications in Civil and Environmental Engineering	62 64
	Hydromechanics and Hydrology	72
Module M0755:		75
	Structural Design	77
Module M0631:	Reinforced Concrete Structures II	81
Module M0730:	Computer Engineering	83
	Water Management	85
	Sanitary Engineering I	87
	Hydraulic Engineering	90
	Bioprocess Engineering	92
	Fundamentals of Process Engineering and Material Engineering Computer Engineering	92 94
	Fundamentals of Fluid Mechanics	94 96
	Biochemistry and Microbiology	98
	Phase Equilibria Thermodynamics	102
	Bioprocess Engineering - Fundamentals	105
Module M0538:	Heat and Mass Transfer	108
	Thermal Separation Processes	110
	Chemical Reaction Engineering	115
	Environmental Technology	119
	Bioprocess Engineering - Advanced Environmental Technology	121 123
	Process and Plant Engineering I	125
	Particle Technology and Solids Process Engineering	125
	Electrical Engineering	130
	Electrical Engineering III: Circuit Theory and Transients	130
	Computer Engineering	132
	Theoretical Electrical Engineering I: Time-Independent Fields	134
	Materials in Electrical Engineering	136
	Mathematics IV	140
	Electrical Machines and Actuators	143
	Introduction to Waveguides, Antennas, and Electromagnetic Compatibility	145
	Introduction to Communications and Random Processes Electrical Power Systems I: Introduction to Electrical Power Systems	147 149
	Theoretical Electrical Engineering II: Time-Dependent Fields	149
	Measurements: Methods and Data Processing	152
	Electronic Devices	156
	Semiconductor Circuit Design	158
	Electrical Engineering Project Laboratory	160
	Energy and Enviromental Engineering	161
Module M0730:	Computer Engineering	161

Module M0933: Fundamentals of Materials Science	164
Module M0598: Mechanical Engineering: Design	166
Module M0536: Fundamentals of Fluid Mechanics	169
Module M0610: Electrical Machines and Actuators	171
Module M0618: Renewables and Energy Systems	173
Module M0956: Measurement Technology for Mechanical Engineers	176
Module M0655: Computational Fluid Dynamics I	179
Module M1275: Environmental Technology	181
Module M0546: Thermal Separation Processes	183
Module M1274: Environmental Technology	188
Module M0538: Heat and Mass Transfer	190
Module M0670: Particle Technology and Solids Process Engineering	192
	194
Specialization Computer Science	
Module M0561: Discrete Algebraic Structures	194
Module M0730: Computer Engineering	195
Module M0852: Graph Theory and Optimization	197
Module M0727: Stochastics	199
Module M0624: Automata Theory and Formal Languages	201
Module M0803: Embedded Systems	201
Module M0553: Objectoriented Programming, Algorithms and Data Structures	205
Module M0731: Functional Programming	207
Module M1578: Seminars Computer Science	209
Module M0834: Computernetworks and Internet Security	210
Module M0662: Numerical Mathematics I	212
Module M0791: Computer Architecture	214
Module M0791: Computer Architecture Module M0562: Computability and Complexity Theory	214
Module M0971: Operating Systems	217
Module M0732: Software Engineering	218
Module M1269: Lab Cyber-Physical Systems	220
Specialization Mechanical Engineering	221
Module M0598: Mechanical Engineering: Design	221
Module M0930: Fundamentals of Materials Science	
	224
Module M0680: Fluid Dynamics	226
Module M0960: Mechanics IV (Oscillations, Analytical Mechanics, Multibody Systems, Numerical Mechanics)	228
Module M0956: Measurement Technology for Mechanical Engineers	230
Focus Biomechanics	233
Module M0597: Advanced Mechanical Engineering Design	233
Module M1277: MED I: Introduction to Anatomy	236
Module M1278: MED I: Introduction to Radiology and Radiation Therapy	238
Module M1279: MED II: Introduction to Biochemistry and Molecular Biology	240
Module M0662: Numerical Mathematics I	241
Module M1333: BIO I: Implants and Fracture Healing	243
Module M0730: Computer Engineering	245
Module M1280: MED II: Introduction to Physiology	247
	248
Module M1332: BIO I: Experimental Methods in Biomechanics	
Module M0934: Advanced Materials	249
Focus Energy Systems	251
Module M0730: Computer Engineering	251
Module M0684: Heat Transfer	253
Modulo M1022: Paciproceeting Machinery	255
	258
Module M0597: Advanced Mechanical Engineering Design	
Module M0655: Computational Fluid Dynamics I	261
Module M0662: Numerical Mathematics I	263
Module M0610: Electrical Machines and Actuators	265
Module M0618: Renewables Energy Systems	267
Focus Aircraft Systems Engineering	270
Module M0597: Advanced Mechanical Engineering Design	270
Madula MOEOG, Advanced Machanical Design Project	273
Module M0730: Computer Engineering	275
Module M0655: Computational Fluid Dynamics I	277
Module M0662: Numerical Mathematics I	279
Module M1320: Simulation and Design of Mechatronic Systems	281
Module M0599: Integrated Product Development and Lightweight Design	283
Module M0865: Fundamentals of Production and Quality Management	285
Madula M07C7: Assessed Costance	287
Focus Materials in Engineering Sciences	
Focus Materials in Engineering Sciences	289
Module M0597: Advanced Mechanical Engineering Design	
	289
Module M0988: Structural Materials	289 292
Madula M0000. Chrysterical Matariala	
Module M0988: Structural Materials Module M0662: Numerical Mathematics I	292
Module M0988: Structural Materials Module M0662: Numerical Mathematics I Module M1009: Material Science Laboratory Modulo M0720: Computer Engineering	292 294 296
Module M0988: Structural Materials Module M0662: Numerical Mathematics I Module M1009: Material Science Laboratory Module M0730: Computer Engineering	292 294 296 298
Module M0988: Structural Materials Module M0662: Numerical Mathematics I Module M1009: Material Science Laboratory Module M0730: Computer Engineering Module M1746: Materials Engineering: Materials Selection, Processing and Modelling	292 294 296 298 300
Module M0988: Structural Materials Module M0662: Numerical Mathematics I Module M1009: Material Science Laboratory Module M0730: Computer Engineering Module M1746: Materials Engineering: Materials Selection, Processing and Modelling Module M1005: Enhanced Fundamentals of Materials Science	292 294 296 298 300 302
Module M0988: Structural Materials Module M0662: Numerical Mathematics I Module M1009: Material Science Laboratory Module M0730: Computer Engineering Module M1746: Materials Engineering: Materials Selection, Processing and Modelling	292 294 296 298 300

Es sus Marshatus ins	200
Focus Mechatronics	308
Module M0597: Advanced Mechanical Engineering Design Module M0708: Electrical Engineering III: Circuit Theory and Transients	308 311
Module M1320: Simulation and Design of Mechatronic Systems	313
Module M0730: Computer Engineering	315
Module M0662: Numerical Mathematics I	317
Module M0610: Electrical Machines and Actuators	319
Module M0777: Semiconductor Circuit Design	321
Module M0854: Mathematics IV	323
Focus Product Development and Production	326
Module M0597: Advanced Mechanical Engineering Design	326
Module M0596: Advanced Mechanical Design Project Module M0726: Production Technology	329 331
Module M0725: Production Engineering	334
Module M0730: Computer Engineering	337
Module M0599: Integrated Product Development and Lightweight Design	339
Module M0865: Fundamentals of Production and Quality Management	341
Focus Theoretical Mechanical Engineering	343
Module M0597: Advanced Mechanical Engineering Design	343
Module M0684: Heat Transfer	346
Module M0655: Computational Fluid Dynamics I	348
Module M0662: Numerical Mathematics I Module M0725: Production Engineering	350 352
Module M0725: Production Engineering Module M0730: Computer Engineering	355
Module M0610: Electrical Machines and Actuators	357
Module M1573: Modeling, Simulation and Optimization (EN)	359
Module M0854: Mathematics IV	360
Specialization Biomedical Engineering	363
Module M0933: Fundamentals of Materials Science	363
Module M0730: Computer Engineering	365
Module M0680: Fluid Dynamics	367
Module M0960: Mechanics IV (Oscillations, Analytical Mechanics, Multibody Systems, Numerical Mechanics) Module M1277: MED I: Introduction to Anatomy	369 371
Module M1277: MED I: Introduction to Radiology and Radiation Therapy	373
Module M0662: Numerical Mathematics I	375
Module M0684: Heat Transfer	377
Module M0956: Measurement Technology for Mechanical Engineers	379
Module M1279: MED II: Introduction to Biochemistry and Molecular Biology	382
Module M1333: BIO I: Implants and Fracture Healing	383
Module M0598: Mechanical Engineering: Design Module M0634: Introduction into Medical Technology and Systems	385 388
Module M0034: Infoduction into Medical Technology and Systems Module M1280: MED II: Introduction to Physiology	390
Module M1332: BIO I: Experimental Methods in Biomechanics	391
Specialization Naval Architecture	392
Module M0730: Computer Engineering	392
Module M1118: Hydrostatics and Body Plan	394
Module M0933: Fundamentals of Materials Science	397
Module M0854: Mathematics IV	399
Module M0960: Mechanics IV (Oscillations, Analytical Mechanics, Multibody Systems, Numerical Mechanics) Module M0680: Fluid Dynamics	402 404
Module M0660: Fluid Dynamics Module M0640: Stochastics and Ship Dynamics	404
Module M0664: Structural Design and Construction of Ships	409
Module M0659: Fundamentals of Ship Structural Design and Analysis	411
Module M1109: Resistance and Propulsion	414
Module M1110: Ship Design	415
Specialization Process Engineering	417
Module M0886: Fundamentals of Process Engineering and Material Engineering	417
Module M0730: Computer Engineering Module M0536: Fundamentals of Fluid Mechanics	419
Module M0530: Fundamentals of Fluid Mechanics Module M0544: Phase Equilibria Thermodynamics	421 423
Module M0938: Bioprocess Engineering - Fundamentals	426
Module M0618: Renewables and Energy Systems	429
Module M0538: Heat and Mass Transfer	432
Module M0546: Thermal Separation Processes	434
Module M0892: Chemical Reaction Engineering	439
Module M1275: Environmental Technology	443
Module M1497: Measurement Technology for VT/ BVT Module M1274: Environmental Technology	445 447
Madula MOEDO, Dragona and Diant Engine and L	447
Module M0539: Process and Plant Engineering T Module M0670: Particle Technology and Solids Process Engineering	452
Thesis	454
Module M-001: Bachelor Thesis	454

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	1
-	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 departm 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 groriented 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 represental 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)
JKIII3	
	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: Elect	rical Engineerin	ig I: Direct C	urrent Networks	and Electromagnet	ic Fields		
Courses							
Title				Тур	Hrs/wk	СР	
Electrical Engineering I: Direct Curr	rent Networks and Electr	omagnetic Fields (LC	0675)	Lecture	3	5	
Electrical Engineering I: Direct Curr	rent Networks and Electr	omagnetic Fields (LC)676)	Recitation Section (small)	2	1	
Module Responsible	Prof. Matthias Kuhl						
Admission Requirements	None						
Recommended Previous							
Knowledge							
Educational Objectives	After taking part succ	essfully, students	have reached the followi	ng learning results			
Professional Competence							
Knowledge							
Skills							
Personal Competence							
Social Competence							
Autonomy							
Workload in Hours	Independent Study Ti	me 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	120 Minutes						
scale							
Assignment for the	General Engineering	Science (German p	orogram, 7 semester): Co	ore Qualification: Compulsory			
Following Curricula	Electrical Engineering	g: Core Qualificatio	n: Compulsory				
	Computational Science	e and Engineering	: Core Qualification: Com	npulsory			
	Mechatronics: Core Q	ualification: Comp	ulsory				
	Orientierungsstudium	n: Core Qualificatio	n: Elective Compulsory				

Course L0675: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields			
Тур	Lecture		
Hrs/wk	3		
СР	5		
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42		
Lecturer	Prof. Matthias Kuhl		
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 		

Тур	Recitation Section (small)			
Hrs/wk	2			
CP	1			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28			
Lecturer	Prof. Matthias Kuhl			
Language	DE			
Cycle	WiSe			
Content				
Literature	 Übungsaufgaben zur Elektrotechnik 1, TUHH, 2013 Ch. Kautz: Tutorien zur Elektrotechnik, Pearson Studium, 2010 			

Module M0889: Mecha	anics I (Sta	tics)				
Courses						
Title				T	Line (colo	67
Hitle Mechanics I (Statics) (L1001)				Typ Lecture	Hrs/wk 2	CP 3
Mechanics I (Statics) (L1001) Mechanics I (Statics) (L1002)				Recitation Section (small)	2	2
Mechanics I (Statics) (L1003)				Recitation Section (large)	1	1
Module Responsible	Prof. Robert Sei	ifried				
	None					
Recommended Previous	Solid school kn	owledge in mat	ematics and physics.			
Knowledge	1					
Educational Objectives	After taking par	t successfully,	udents have reached the fol	lowing learning results		
Professional Competence						
Knowledge	The students ca	an				
	l					
			ocedure used in mechanical	contexts;		
			n model design;			
	 present t 	echnical know	dge in stereostatics.			
Skills	The students ca	an				
	 explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context their own problems; 					
						y it to the contex
	 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	the reach and	oundaries of statical method	s and extend them to be applica	ble to wider probl	em sets.
Personal Competence	l					
Social Competence	The students can work in groups and support each other to overcome 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	Independent St	udy Time 110,	tudy Time in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonu		Description			
	No 20 9	% Midteri	Wird nur	im WiSe angeboten		
	90 min					
scale						
-	-	-		: Core Qualification: Compulsory		
Following Curricula		-	ering: Core Qualification: Co	mpulsory		
	-	-	ualification: Compulsory			
	Mechatronics: C					
	-		lification: Elective Compulso	ry		
	Nous Architect	uro: Coro Ouali	cation: Compulsory			

Course L1001: Mechanics I (statics)					
Тур	Lecture					
Hrs/wk						
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 (S	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 (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				
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
Linear Algebra I (L0914)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous Knowledge	School mathematics			
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence	Arter taking pare successivity, students have reached the	ronowing learning results		
-				
Knowledge	 Students can name the basic concepts in analy 	sis and linear algebra. They are abl	e to explain the	em using appropriate
	examples.			···· ••···· • • • • • • • • • • • • • •
	 Students can discuss logical connections between 	these concepts. They are canable	of illustrating th	aca connections with
		These concepts. They are capable	or muscracing th	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce the 	em.		
Skills				
	 Students can model problems in analysis and line 	ear algebra with the help of the conce	pts studied in th	nis course. Moreover
	they are capable of solving them by applying esta	blished methods.		
	 Students are able to discover and verify further lo 	gical connections between the concep	ots studied in the	e course.
	 For a given problem, the students can develop 	and execute a suitable approach, a	nd are able to c	ritically evaluate the
	results.			2
	(courtor			
Personal Competence				
Social Competence				
	 Students are able to work together in teams. They 			
	 In doing so, they can communicate new concepts 	according to the needs of their coop	erating partners	. Moreover, they car
	design examples to check and deepen the unders	tanding of their peers.		
Autonomy				
Autonomy	 Students are capable of checking their understar 	nding of complex concepts on their o	wn. They can sp	ecify open questions
	precisely and know where to get help in solving the	nem.		
	 Students have developed sufficient persistence 	to be able to work for longer period	s in a goal-orien	ted manner on hard
	problems.		5	
	P			
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 I) + 60 min (Linear Algebra I)			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Core Qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Core Qualification			
,	Bioprocess Engineering: Core Qualification: Compulsory			
	1 5 5 1			
	Electrical Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification			
	Computational Science and Engineering: Core Qualification	ion: Compulsory		
	Logistics and Mobility: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory			
	Mechatronics: Core Qualification: Compulsory			
	Orientierungsstudium: Core Qualification: Elective Comp	ulsory		
	Naval Architecture: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory			

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	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

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 R^n, 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	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Anusch Taraz, Prof. Marko Lindner	
Language	DE	
Cycle	WiSe	
Content	 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 Algebr	urse 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 Solv	ing Course) (L0368)	Recitation Section (small)	1	1
Module Responsible	Prof. Manfred Eich			
Admission Requirements	None			
Recommended Previous Knowledge	 Calculus and linear algebra on high so Physics on high school level 	thool level		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics.			
	Students can relate physics topics to technical problems.			
Skills	Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise.			
Personal Competence				
Social Competence	Students can jointly solve subject related pro problem solving courses.	oblems in groups. They can present their results	effectively within	the framework of t
Autonomy	the lecture. They can reflect their acquired	ormation from the provided references and to rud level of expertise with the help of lecture action of connect their knowledge with that acquired from	companying mea	
Workload in Hours	Independent Study Time 78, Study Time in L	ecture 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 progr	am, 7 semester): Core Qualification: Compulsory	1	

Course L0367: Physics for Engineers		
Тур	Lecture	
Hrs/wk	2	
CP		
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 	

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

Module M0687: Chem	ictry				
Module M0007: Chem	istry				
Courses					
Гitle		Тур	ŀ	lrs/wk	СР
Chemistry I (L0460)		Lecture	2	1	2
Chemistry I (L0475)		Recitation Section	on (large) 1		1
Chemistry II (L0465)		Lecture	2	1	2
Chemistry II (L0476)		Recitation Section	on (large) 1		1
Module Responsible	Dr. Dorothea Rechtenbach				
Admission Requirements	None				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following learning resu	llts		
Professional Competence					
Knowledge	The students are able to name and to descr		-		
	table, chemical bonds), physical chemist	ry (aggregate states, separating	processes, thermo	odynamics,	kinetics), inorgani
	chemistry (acid/base, pH-value, salts, solub	ility, redox, metals) and organic che	emistry (aliphatic h	ydrocarbon	s, functional groups
	carbonyl compounds, aromates, reaction n	nechanisms, natural products, synth	netic polymers). Fu	rthermore s	students are able t
	explain basic chemical terms.				
Skills	After successful completion of this module s	tudents are able to describe substar	nce groups and che	mical comp	ounds. On this basis
	they are capable of explaining, choosing an				
Personal Competence					
	Students are able to take part in discussion	s on chemical issues and problems a	is a member of an i	interdiscipli	nary team. They ca
Secial competence	contribute to those discussion by their own			incer diberphi	
Autonomy	After successful completion of this module	students are able to solve chemica	al problems indene	ndently by	defending propose
Autonomy	approaches with arguments. They can also			nachtry by	derending propose
	approaches war arguments. They can also	accument their approaches.			
Workload in Hours	Independent Study Time 96, Study Time in	ecture 84			
Credit points	6				
Course achievement	None				
	Written exam				
Examination duration and	120 min				
scale					
	General Engineering Science (German prog	am 7 semester): Core Qualification	Compulsony		
Following Curricula	Civil- and Environmental Engineering: Core		compuisory		
ronowing curricula					
	Technomathematics: Specialisation III. Engin	ieering science: Elective Compulsor	ý		

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.	

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	Course L0465: 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 Programming in C (L0083)		Typ Lecture	Hrs/wk	CP 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 h	ave reached the following learning results		
Professional Competence				
Knowledge	The students know by heart the basic syr	ntax of C programming as well as its meaning, i	ntent and	
	purpose.			
	They know the fundamental common ante	and mindiales of elementary provided by		
	based on C programming and can explain	and principles of elementary procedural progra	imming	
	based on e programming and can explain	r them.		
	 basic data types (integers, floating point 	nt numbers, characters)		
		strings, composed data types, type conversion)	
	operators (arithmetical operations, logi			
	control flow (choice, loops, jumps, cond	litional compilation)		
	 functions and macros important standard libraries and function 			
	recursion	5115		
	Inked lists			
		programming lectures like object oriented prog	gramming in C++.	
Skills		ted development environment for C programm	ing on a PC	
	so that they can write, store, compile and	d execute C programs on it.		
	Using their knowledge they are able to re	ad and understand given C Programs.		
	They can solve simple algorithmic proble in C language.	ms on their own and can model and program th	eir solutions	
	The students are able to calve colorised a	versions from other eress of their study like me	themetice	
		exercises from other areas of their study like ma sics with the aid of small C programs/-projects r		
	meenames, electrical engineering of phys	sies with the did of small e programs/-projects r	lumencany.	
Personal Competence				
Social Competence		ams to solve given weekly tasks, to identify and	l analyze	
	programming errors and to present their	results.		
	They are able to explain simple phenome	ena to each other directly at the PC.		
Autonomy	The students prepare themselves using t	he given teaching material and solve the given		
	programming exercises on their own.	····		
		to understand and check addressed issues and	also to	
	gain a certain programming experience.			
	For details beyond the scope of the lecture	re the students inform themselves using the sta	ated	
	literature and / or by supplementary own	research.		
Workload in Hours	Independent Study Time 32, Study Time	in Lecture 28		
Credit points				
Course achievement				
	Written elaboration			
Examination duration and	1-2 coding tasks weekly			
scale	Concern Engineering Spin (C			
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Core Qualification: Compu	isory	

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 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

Module M0547: Elect	rical Engineering II: Alternating Curre	nt Networks and Basic De	vices	
Courses				
Title		Тур	Hrs/wk	СР
	g Current Networks and Basic Devices (L0178)	Lecture	3	5
Electrical Engineering II: Alternatin	g 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 t	he following learning results		
Professional Competence	Students are able to reproduce and explain fundame	ntal theories principles and methods	rolated to the	theory of alternati
Knowledge	currents. They can describe networks of linear elemen			-
	an overview of applications for the theory of alternat		-	
	explaining the behavior of fundamental passive and ac			
Skills	Students are capable of calculating parameters within	n simple electrical networks at alterna	ting currents by	means of a compl
	notation for voltages and currents. They can apprai	se the fundamental effects that may	occur within el	lectrical networks
	alternating currents. Students are able to analyze s	simple circuits such as oscillating cir	cuits, filter, and	matching networ
	quantitatively and dimension elements by means of	a design. They can motivate and just	tify the fundame	ental elements of
	electrical power supply (transformer, transmission line	e, compensation of reactive power, mu	ultiphase system)	and are qualified
	dimension their main features.			
Personal Competence				
-	Students are able to work together on subject related t	asks in small groups. They are able to	present their res	ults effectively.
Autonomy	Students are capable to gather necessary information	from the references provided and relation	ate that informat	ion to the context
	the lecture. They are able to continually reflect their kn			
	tests and exercises that are related to the exam. Bas			
	learning process. They are able to draw connections		this lecture and	the content of oth
	lectures (e.g. Electrical Engineering I, Linear Algebra, a	nd Analysis).		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70)		
Credit points	6			
Course achievement	Compulsory Bonus Form Des	cription		
	No 10 % Midterm			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Core Qualification: Compulsory		
Following Curricula	Electrical Engineering: Core Qualification: Compulsory			
	Computational Science and Engineering: Core Qualifica	ition: Compulsory		
	Mechatronics: Core Qualification: Compulsory			
	Orientierungsstudium: Core Qualification: Elective Com	ipulsory		

Course L0178: Electrical Engineering II: Alternating Current Networks and Basic Devices		
Тур	Lecture	
Hrs/wk	3	
СР	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 Engineering 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 Knowledge	 Basic knowledge about mechanics an Internship (Stage I Practical) 	d 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:		
	 explain basic working principles and f 			
		ia, application scenarios and practical exampl	es of basic machi	ne elements, indica
	the background of dimensioning calcu	llations.		
Skills	After passing the module, students are able	to:		
	accomplish dimensioning calculations of covered machine elements,			
		of covered machine elements, dule to new requirements and tasks (problem s		
	 recognize the content of technical dra 		olving skins),	
	 technically evaluate basic designs. 	wings and schematic sketches,		
Personal Competence				
Social Competence	Students are able to discuss technical	information in the lecture supported by activat	ing methods.	
Autonomy				
		eepen their acquired knowledge in exercises.		
		al knowledge and to recapitulate poorly unde	rstood content e.	g. by using the vide
	recordings of the lectures.			
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			
scale				
Assignment for the	General Engineering Science (German progr	am, 7 semester): Core Qualification: Compulsor	У	
Following Curricula	Energy and Environmental Engineering: Core			
	Logistics and Mobility: Core Qualification: Co			
	Mechanical Engineering: Core Qualification:			
	Mechatronics: Core Qualification: Compulsor	•		
	Orientierungsstudium: Core Qualification: Ele			
	Naval Architecture: Core Qualification: Comp			
	Technomathematics: Specialisation III. Engin	eering science: Elective Compulsory		

_	s of Mechanical Engineering Design		
	Lecture		
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

6				
Courses				
Title		Тур	Hrs/wk	СР
Mechanics II (L0493)		Lecture	2	2
Mechanics II (L0494) Mechanics II (L1691)		Recitation Section (small) Recitation Section (large)	2	2
Module Responsible	Prof. Christian Cyron			
Admission Requirements				
Recommended Previous	Mechanics I			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students name the fundamental concepts and laws of statics such as stresses, strains, Hooke's linear law.			
Skills	The students apply the mathematical/mechanical analysis and modeling.			
	The students apply the fundamental met	hods of elasto statics to simply engineering problem	c	
		indus of elasto statics to simply engineering problem.	5.	
	The students estimate the validity and li	mitations of the introduced methods.		
Personal Competence				
Social Competence	-			
Autonomy	-			
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				
Assignment for the	General Engineering Science (German pr	rogram, 7 semester): Core Qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Co	re Qualification: Compulsory		
	Mechanical Engineering: Core Qualificati	on: Compulsory		
	Mechatronics: Core Qualification: Compu	lsory		
	Orientierungsstudium: Core Qualification	: Elective Compulsory		
	Naval Architecture: Core Qualification: C	ompulsory		

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	ourse 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, Dr. Konrad Schneider	
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		Recitation Section (large)	1	1
Technical Thermodynamics I (L044		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
	Elementary knowledge in Mathematics and Mech	anics		
Knowledge				
	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermod	ynamics. They know the relation of the kind	ds of energy acc	ording to 1 st law o
	Thermodynamics and are aware about the limits	of energy conversions according to $2^{\mbox{nd}}$ law	of Thermodynan	nics. They are able t
	distinguish between state variables and process	s variables and know the meaning of differ	ent state variab	les like temperature
	enthalpy, entropy and also the meaning of exe	ergy and anergy. They are able to draw the	e Carnot cycle ir	a Thermodynamic
	related diagram. They know the physical different	-		
	state. They know the meaning of a fundamental	state of equation and know the basics of two	phase Thermody	ynamics.
Skills	Students are able to calculate the internal energ			
	simple change of states and to use this calculatio		culate state varia	ables for an ideal an
	for a real gas from measured thermal state varia	bles.		
Demonstration of the second				
Personal Competence	The students are able to discuss in small groups	and develop on ennroach		
	Students are able to define independently tasks,		dao as woll as to	find ways to use th
Autonomy	knowledge in practice.	to get new knowledge from existing knowle	uge as well as to	iniu ways to use th
	klowledge in proceee.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	cure 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: Comp	pulsory		
	Energy and Environmental Engineering: Core Qua			
	General Engineering Science (English program, 7			
	Computational Science and Engineering: Speciali		Ilsory	
	Mechanical Engineering: Core Qualification: Com	pulsory		
	Mechatronics: Core Qualification: Compulsory	- Commutation		
	Orientierungsstudium: Core Qualification: Electiv			
	Naval Architecture: Core Qualification: Compulso			
	Technomathematics: Specialisation III. Engineerin			
	Process Engineering: Core Qualification: Compuls	богу		

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

Module M0851: Math	ematics II			
Courses				
Title		Typ	Hrs/wk	СР
Analysis II (L1025)		Typ Lecture	2	2
Analysis II (L1026)			2	1
Analysis II (L1020)		Recitation Section (large) Recitation Section (small)	1	1
Linear Algebra II (L0915)		Lecture	2	2
Linear Algebra II (L0915)		Recitation Section (small)	1	1
			1	1
Linear Algebra II (L0917)		Recitation Section (large)	T	T
Module Responsible Admission Requirements	Prof. Anusch Taraz None			
Recommended Previous	Mathematics I			
Keconmended Previous Knowledge	Mathematics I			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence	······································			
-				
Knowledge	 Students can name further concepts in analys 	is and linear algebra. They are able	to explain the	m using appropriat
	examples.	<u> </u>		5 11 1
	 Students can discuss logical connections between 	n these concents They are canable	of illustrating th	asa connections wit
	the help of examples.	in these concepts. They are capable	or muscialing th	ese connections wit
	 They know proof strategies and can reproduce the 	em.		
Skills				
	 Students can model problems in analysis and lin 	ear algebra with the help of the conce	pts studied in th	is course. Moreover
	they are capable of solving them by applying est	ablished methods.		
	 Students are able to discover and verify further least 	gical connections between the conce	ots studied in the	course.
	 For a given problem, the students can develop 	and execute a suitable approach, and	nd are able to ci	ritically evaluate th
	results.			
Personal Competence				
Social Competence				
	 Students are able to work together in teams. The 			
	 In doing so, they can communicate new concept 	s according to the needs of their coop	erating partners	. Moreover, they ca
	design examples to check and deepen the under	standing of their peers.		
Autonomy				
Autonomy	 Students are capable of checking their understa 	nding of complex concepts on their o	wn. They can sp	ecify open question
	precisely and know where to get help in solving t	hem.		
	 Students have developed sufficient persistence 		s in a goal-orien	ted manner on har
	problems.			
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lecture 11	2		
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Analysis II) + 60 min (Linear Algebra II)			
scale	-			
Assignment for the	General Engineering Science (German program, 7 seme	ster): Core Qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Core Qualification			
i onowing curricula				
	Bioprocess Engineering: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification	on: Compulsory		
	Computational Science and Engineering: Core Qualificat	ion: Compulsory		
	Logistics and Mobility: Core Qualification: Compulsory			
	Mechanical Engineering: Core Qualification: Compulsory			
	Mechatronics: Core Qualification: Compulsory			
		aulson/		
	Orientierungsstudium: Core Qualification: Elective Comp	Juisol y		
	Naval Architecture: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory			

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

Course L1027: Analysis II	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	

urse L0915: Linear Algebra	a II
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	SoSe
Content	 general vector spaces: subspaces, Euclidean vector spaces linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices system of linear differential equations matrix factorizations: LR-decomposition, QR-decomposition, Schur decomposition, Jordan normal form, singular value decomposition
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 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	rof. 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 Algebr	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, Dr. Christian Seifert, Dr. Julian Großmann, Prof. Marko Lindner		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

C				
Courses				
Fitle		Тур	Hrs/wk	СР
Technical Thermodynamics II (L044 Technical Thermodynamics II (L045		Lecture Recitation Section (large)	2 1	4 1
Technical Thermodynamics II (L045		Recitation Section (angle)	1	1
Module Responsible				
Admission Requirements	None			
•	Elementary knowledge in Mathematics, Mech	vanice and Technical Thormodynamice I		
Recommended Previous Knowledge	Elementary knowledge in Mathematics, Mech	lanics and recinical mermodynamics i		
	After taking part successfully, students have	reached the following learning results		
Professional Competence	After taking part successfully, students have	reached the following learning results		
Skills	derive energetic and exergetic efficiencies clockwise and clockwise cycles (heat-power draw the different cycles in Thermodynam processes and are able to perform simple co know the definition of the speed of sound an Students are able to use thermodynamic law exergy- and entropy balances and by this to	cesses like Joule, Otto, Diesel, Stirling, Seiliger and know the influence different factors. Th cycle, cooling cycle). They have increased kno ics related diagrams. They know the laws of mbustion calculations. They are provided with d know about a Laval nozzle. ws for the design of technical processes. Especie optimise technical processes. They are able to They are able to transform a verbal formula	ey know the diffe wledge of steam c gas mixtures, esp basic knowledge ally they are able o perform simple s	erence between a ycles and are able becially of humid in gas dynamics a to formulate energy safety calculations
Personal Competence				
Social Competence	The students are able to discuss in small gro	ups and develop an approach.		
Autonomy	Students are able to define independently ta knowledge in practice.	sks, to get new knowledge from existing knowl	edge as well as to	find ways to use t
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
	General Engineering Science (German progra	am, 7 semester): Core Qualification: Compulson	/	
-	Bioprocess Engineering: Core Qualification: C		,	
	Energy and Environmental Engineering: Core			
	Energy Systems: Technical Complementary (
	Engineering Science: Core Qualification: Com			
	Engineering Science: Specialisation Mechanic			
	5 5	m, 7 semester): Core Qualification: Compulsory		
		m, 7 semester): Specialisation Mechanical Engi		ompulsory
		cialisation Engineering Sciences: Elective Comp		
	Mechanical Engineering: Core Qualification: (
	Mechatronics: Core Qualification: Compulsor	/		
	Mechatronics: Core Qualification: Compulsor Technomathematics: Specialisation III. Engin			

Course L0449: Technical Thermodynamics II		
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Schmitz	
Language	DE	
Cycle	WiSe	
Content	8. Cycle processes	
	7. Gas - vapor - mixtures	
	10. Open sytems with constant flow rates	
	11. Combustion processes	
	12. Special fields of Thermodynamics	
Literature	• 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 The	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	

Module M0959: Mech	anics III (Dynamics)			
Courses				
		T	Have to also	<u></u>
Title		Typ Lecture	Hrs/wk 3	СР 3
Mechanics III (Dynamics) (L1134) Mechanics III (Dynamics) (L1135)		Recitation Section (small)	2	2
Mechanics III (Dynamics) (L1136)		Recitation Section (Iarge)	1	1
	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	Mathematics I, II, Mechanics I (Statics)			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence		· · ·		
Knowledge	The students can			
	describe the axiomatic procedure			
	explain important steps in model of	-		
	 present technical knowledge in stereostatics. 			
Skills	The students can			
			formation and an	
		f mathematical / mechanical analysis and model	formation, and appl	ly it to the context
	their own problems;	ic and kinetic methods to engineering problems;		
			icable to wider prob	lom coto
	 estimate the reach and boundaries 	s of statical methods and extend them to be appl		iem sets.
Personal Competence				
Social Competence	The students can work in groups and sup	port each other to overcome difficulties.		
Autonomy	Students are capable of determining thei	r own strengths and weaknesses and to organize	their time and learr	ning based on thos
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	ogram, 7 semester): Core Qualification: Compuls	ory	
Following Curricula	Data Science: Core Qualification: Elective	Compulsory		
	Digital Mechanical Engineering: Core Qua	alification: Compulsory		
	Mechanical Engineering: Core Qualification	on: Compulsory		
	Mechatronics: Core Qualification: Compu	lsory		
	Naval Architecture: Core Qualification: Co	ompulsory		
	Technomathematics: Specialisation III. Er	aning aning Calendary Flacting Computers		

urse L1134: Mechanics III	(Dynamics)
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	WiSe
Content	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
	•
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3 und 4. 11. Auflage, Springer (2011).

Typ 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	
CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Robert Seifried Language DE Cycle WiSe	
Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Robert Seifried Language DE Cycle WiSe	
Lecturer Prof. Robert Seifried Language DE Cycle WiSe	
Language DE Cycle WiSe	
Cycle WiSe	
Content Con interleating course	
Content See Interlocking course	
Literature See interlocking course	

Yeitation Section (large) Restation Section (large) Instruction I Yeitation Section (large) Instruction I Yeitation Section (large) Instruction Instrest Instruction	Course L1136: Mechanics III	(Dynamics)
CP 1 Workload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecture Prof. Robert Seifried DE Vise Content See interlocking course	Тур	Recitation Section (large)
Workload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecture Prof. Robert Seifried Language DE Cycle Wise Content See interlocking course	Hrs/wk	1
Lecturer Prof. Robert Seifried Language DE Cycle WiSe Content See interlocking course	СР	1
Language DE Cycle WiSe Content See interlocking course	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Cycle WiSe Content See interlocking course	Lecturer	Prof. Robert Seifried
Content See interlocking course	Language	DE
5	Cycle	WiSe
Literature See interlocking course	Content	See interlocking course
	Literature	See interlocking course

Module M0853: Mathe	ematics III			
Courses				
Title		True		CD.
Analysis III (L1028)		Typ Lecture	Hrs/wk 2	CP 2
Analysis III (L1029)		Recitation Section (small)	1	1
Analysis III (L1030)		Recitation Section (large)	1	1
Differential Equations 1 (Ordinary E	ifferential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary E	Differential Equations) (L1032)	Recitation Section (small)	1	1
Differential Equations 1 (Ordinary E	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 reached	d the following learning results		
Professional Competence				
Knowledge				
nite medge	 Students can name the basic concepts in the a 	area of analysis and differential equations	s. They are able	to explain them usi
	appropriate examples.			
	 Students can discuss logical connections betw 	ween these concepts. They are capable	of illustrating th	ese connections w
	the help of examples.			
	They know proof strategies and can reproduce	e them.		
Skills				
Skiis	 Students can model problems in the area of a 	nalysis and differential equations with th	e help of the co	ncepts studied in t
	course. 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 t
	results.			
Personal Competence				
Social Competence				
	 Students are able to work together in teams. 			
	 In doing so, they can communicate new concerning 		erating partners	. Moreover, they c
	design examples to check and deepen the uno	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
	precisely and know where to get help in solvir		with they can sp	centy open questio
	 Students have developed sufficient persisten 		s in a goal-orier	ted manner on ha
	problems.	ice to be able to work for longer period	s in a goal-onei	
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lecture	112		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Analysis III) + 60 min (Differential Equations	1)		
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Core Qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Core Qualificat	tion: Compulsory		
	Bioprocess Engineering: Core Qualification: Compuls	ory		
	Computer Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory			
	Digital Mechanical Engineering: Core Qualification: C	compulsory		
	Electrical Engineering: Core Qualification: Compulsor	ТУ Т		
	Energy and Environmental Engineering: Core Qualific	cation: Compulsory		
	Engineering Science: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 ser			
	Computational Science and Engineering: Core Qualifi			
	Mechanical Engineering: Core Qualification: Computs			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Process Engineering: Core Qualification: Compulsory			
	riocess Engineering. Core Quanifeation. Compuisory			

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	
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 Equations 1 (Ordinary Differential Equations)	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of the theory and numerical treatment of ordinary differential equations
Literature	 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

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
ourse L1033: Differential E	quations 1 (Ordinary Differential Equations)
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe

Content

Literature

See interlocking course

See interlocking course

Courses				
Title		Turn	Hre /urk	СР
Signals and Systems (L0432)		Typ Lecture	Hrs/wk 3	4
Signals and Systems (L0433)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous				
Knowledge				
-	The modul is an introduction to the theory of signals and 1-3 is expected. Further experience with spectral transf but not required.		-	
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence	······	· · · · · · · · · · · · · · · · · · ·		
Knowledge	The students are able to classify and describe signals at theory. They are able to apply the fundamental transfor can describe and analyse deterministic signals and sys understand the effects in time domain and image dom discrete-time signal.	rmations of continuous-time and disc tems mathematically in both time a	rete-time signals nd image domair	and systems. T n. In particular, 1
Skills	The students are able to describe and analyse determin system theory. They can analyse and design basic s response, stability, linearity etc They can assess the im	systems regarding important proper	ties such as ma	gnitude and ph
Personal Competence				
Social Competence	The students can jointly solve specific problems.			
Autonomy	The students are able to acquire relevant information knowledge during the lecture period by solving tutorial p		-	ontrol their leve
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	ster): Core Qualification: Compulsory		
Following Curricula	Computer Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semest			
	General Engineering Science (English program, 7 semest			У
	General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 se Compulsory	emester): Specialisation Mechanica	Engineering, F	
	General Engineering Science (English program, 7 ser Compulsory General Engineering Science (English program, 7 ser	·		
	Engineering: Compulsory General Engineering Science (English program, 7 senes)		5 5.	5
	Sciences: Compulsory General Engineering Science (English program, 7 s		5.	5
	Compulsory General Engineering Science (English program, 7 semes	·		
	Engineering: Compulsory General Engineering Science (English program, 7 semest	ter): Specialisation Process Engineeri	ng: Compulsory	
	General Engineering Science (English program, 7 semest Computational Science and Engineering: Core Qualificati		ering: Compulsor	У
	Mechatronics: Core Qualification: Compulsory			

Course L0432: Signals and S	ystems
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	Introduction to signal and system theory
	• Signals
	Classification of signals
	 Continuous-time and discrete-time signals
	 Analog and digital signals

- Deterministic and random signals
- Description of LTI systems by differential equations or difference equations, respectively
- Basic properties of signals and operations on signals
- Elementary signals
- Distributions (Generalized Functions)
- Power and energy of signals
- Correlation functions of deterministic signals
 - Autocorrelation functionCrosscorrelation function

 - Orthogonal signals
 - Applications of correlation
- Linear time-invariant (LTI) systems
 - LinearityTime-invariance
 - Description of LTI systems by impulse response and frequency response
 - Convolution
 - Convolution and correlation
 - Properties of LTI-systems
 - Causal systems
 - Stable systems
 - Memoryless systems
- Fourier Series and Fourier Transform
 - Fourier transform of continuous-time signals, discrete-time signals, periodic signals, non-periodic signals
 - Properties of the Fourier transform
 - Fourier transform of some basic signals
 - Parseval's theorem
- Analysis of LTI-systems and signals in the frequency domain
 - Frequency response, magnitude response and phase response
 - Transmission factor, attenuation, gain
 - Frequency-flat and frequency-selective LTI-systems
 - Bandwidth definitions
 - · Basic types of systems (filters), lowpass, highpass, bandpass, bandstop systems
 - Phase delay and group delay
 - Linear-phase systems
 - Distortion-free systems
 - Spectrum analysis with limited observation window: Leakage effect
- Laplace Transform
 - Relation of Fourier transform and Laplace transform
 - Properties of the Laplace transform
 - Laplace transform of some basic signals
- Analysis of LTI-systems in the s-domain
 - Transfer function of LTI-systems
 - Relation of Laplace transform, magnitude response and phase response
 - Analysis of LTI-systems using pole-zero plots
 - Allpass filters
 - Minimum-phase, maximum-phase and mixed phase filters
 - Stable systems
- Sampling
 - Sampling theorem
 - Reconstruction of continuous-time signals in frequency domain and time domain
 - Oversampling
 - Aliasing
 - Sampling with pulses of finite duration, sample and hold
- Decimation and interpolation
- Discrete-Time Fourier Transform (DTFT)
 - Relation of Fourier transform and DTFT
 - Properties of the DTFT
- Discrete Fourier Transform (DFT)
 - Relation of DTFT and DFT
 - Cyclic properties of the DFT
 - DFT matrix
 - Zero padding
 - Cyclic convolution
 - Fast Fourier Transform (FFT)
 - Application of the DFT: Orthogonal Frequency Division Multiplex (OFDM)
- Z-Transform
 - Relation of Laplace transform, DTFT, and z-transform
 - Properties of the z-transform
 - Z-transform of some basic discrete-time signals
- Discrete-time systems, digital filters
 - FIR and IIR filters
 - Z-transform of digital filters
 - Analysis of discrete-time systems using pole-zero plots in the z-domain
 - Stability
 - Allpass filters

	 Minimum-phase, maximum-phase and mixed-phase filters Linear phase 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
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							
litle		Typ	Hrs/wk	СР			
ntroduction to Control Systems (L	0654)	Typ Lecture	нгs/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 an	nd frequency domain, Laplace transform					
Knowledge							
	After taking part successfully, students have rea	ched the following learning results					
Professional Competence							
Knowledge	Students can represent dynamic system b	behavior in time and frequency domain, and	can in particular	explain properties			
	first and second order systems						
	They can explain the dynamics of simple	control loops and interpret dynamic propertie	es in terms of free	quency response a			
	root locus	wice and the stability proving deviced from i					
	 They can explain the Nyquist stability crite They can explain the role of the phase ma 						
	 They can explain the role of the phase ma They can explain the way a PID controller 						
	 They can explain issues arising when cont 			digitally			
CI-III-							
Skills	• Students can transform models of linear d	ynamic systems from time to frequency dom	nain and vice vers	a			
	 They can simulate and assess the behavior 	or of systems and control loops					
	They can design PID controllers with the h						
	They can analyze and synthesize simple c						
	 They can calculate discrete-time appro implementation 	oximations of controllers designed in cor	itinuous-time an	d use it for digi			
	They can use standard software tools (Ma	tlab Control Toolbox, Simulink) for carrying o	ut these tasks				
		···· · · · · · · · · · · · · · · · · ·					
Personal Competence							
	Students can work in small groups to jointly solve						
Autonomy	Students can obtain information from provided	sources (lecture notes, software document	Autonomy Students can obtain information from provided sources (lecture notes, software documentation, experiment gu				
	when colving given problems						
	when solving given problems.						
	when solving given problems. They can assess their knowledge in weekly on-lir	ne tests and thereby control their learning pr	ogress.				
		ne tests and thereby control their learning pr	ogress.				
		ne tests and thereby control their learning pr	ogress.				
		ne tests and thereby control their learning pr	ogress.				
Workload in Hours			ogress.				
Workload in Hours Credit points	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect		ogress.				
	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6		ogress.				
Credit points Course achievement	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6		ogress.				
Credit points Course achievement	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam		ogress.				
Credit points Course achievement Examination	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam		ogress.				
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam	ture 56					
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program,	ture 56 7 semester): Core Qualification: Compulsory					
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program,	7 semester): Core Qualification: Compulsory					
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Com Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory					
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Electrice Compu Electrical Engineering: Core Qualification: Compu	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory					
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory					
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Enginee	ring: Compulsory				
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Ilsory Jlsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering:	ring: Compulsory Compulsory				
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qua General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering: ' semester): Specialisation Bioprocess Engine	ring: Compulsory Compulsory eering: Compulsor	ry			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering: ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro	ring: Compulsory Compulsory eering: Compulsor omental Engineer	ry			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering: ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science	ring: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory	ry ing: Compulsory			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering: ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science	ring: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory	ry ing: Compulsory			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7 Gener	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ? semester): Specialisation Electrical Engineer ? semester): Specialisation Civil Engineering: ? semester): Specialisation Bioprocess Engine ? semester): Specialisation Energy and Enviro ? semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanica	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, F	ry ing: Compulsory Focus Biomechanic			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7 Gener	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc	ry ing: Compulsory Focus Biomechanic us Energy System			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7 Gomulsory General Engineering Science (English program, 7 Compulsory General Engineering Science (English program, 7 General Engineering Science (English program, 7 Compulsory General Engineering Science (English program, 7 Compulsory General Engineering Science (English program, 7 Compulsory	7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc	ry ing: Compulsory Focus Biomechanic us Energy System			
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 Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Comput Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ulsory alification: Compulsory 2 semester): Specialisation Electrical Engineer 2 semester): Specialisation Bioprocess Engine 2 semester): Specialisation Energy and Enviro 2 semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory Il Engineering, Foc Engineering, Foc	ry ing: Compulsory Focus Biomechanic us Energy System rus Aircraft System			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program)	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ulsory alification: Compulsory 2 semester): Specialisation Electrical Engineer 2 semester): Specialisation Bioprocess Engine 2 semester): Specialisation Energy and Enviro 2 semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory Il Engineering, Foc Engineering, Foc	ry ing: Compulsory cocus Biomechanic us Energy System us Aircraft Syster			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program), 7 Sciences: Compulsory	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ulsory Jisory Jisory Jification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsory mental Engineer e: Compulsory al Engineering, Foc Engineering, Foc Engineering, Foc eering, Focus Mat	ry ing: Compulsory focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerin			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program Compulsory General Engineering Science (English program Engineering: Compulsory General Engineering Science (English program, 7 Science (English program, 7 Scie	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ulsory Jisory Jisory Jification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsory mental Engineer e: Compulsory al Engineering, Foc Engineering, Foc Engineering, Foc eering, Focus Mat	ry ing: Compulsory focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerin			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, General Engineering Science (English program, Compulsory General Engineering Science (English program, Sciences: Compulsory General Engineering Science (English program, Sciences: Compulsory	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ilsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical r semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsory mental Engineer e: Compulsory al Engineering, Foc Engineering, Foc Engineering, Focus Mat al Engineering, I	ry ing: Compulsory Focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerii Focus Mechatronic			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ilsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical r semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical	ering: Compulsory Compulsory eering: Compulsory mental Engineer e: Compulsory al Engineering, Foc Engineering, Foc Engineering, Focus Mat al Engineering, I	ry ing: Compulsory Focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerii Focus Mechatronic			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, General Engineering Science (English program, Sciences: Compulsory General Engineering Science (English program,	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ilsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Envird ' semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical r semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc Engineering, Foc eering, Focus Mal al Engineering, I ineering, Focus P	ry ing: Compulsory Focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerii Focus Mechatronic Product Developme			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, General Engineering Science (English program, Sciences: Compulsory General Engineering Science (English program, And Production: Compulsory	ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ilsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Envird ' semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical r semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc Engineering, Foc eering, Focus Mal al Engineering, I ineering, Focus P	ry ing: Compulsory Focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerii Focus Mechatronic Product Developme			
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, General Engineering Science (English program, Sciences: Compulsory General Engineering Science (English program, And Production: Compulsory General Engineering Science (English program, and Production: Compulsory General Engineering Science (English program, and Production: Compulsory	ture 56 7 semester): Core Qualification: Compulsory Mathematics: Elective Compulsory Jisory alification: Compulsory isory alification: Compulsory 'semester): Specialisation Electrical Engineer 'semester): Specialisation Electrical Engineering: 'semester): Specialisation Energy and Envird 'semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical 'semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical 'semester): Specialisation Mechanical Engin 'semester): Specialisation Mechanical Engin	ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc Engineering, Foc Engineering, Focus Mal al Engineering, I ineering, Focus P neering, Focus Th e: Compulsory	ry ing: Compulsory Focus Biomechanic us Energy System tus Aircraft System terials in Engineerin Focus Mechatronic Product Developme			

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory
Logistics and Mobility: Specialisation Information Technology: Elective Compulsory
Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory
Logistics and Mobility: Specialisation Production Management and Processes: 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
Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory
Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory
Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective
Compulsory

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

Course L0655: Introduction t	ourse L0655: Introduction to Control Systems		
Тур	itation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	pendent Study Time 32, Study Time in Lecture 28		
Lecturer	. Herbert Werner		
Language			
Cycle	Se		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Management Tutorial (L0882)		Recitation Section (small)	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	d the following learning results		
Professional Competence				
Knowledge	After taking this module, students know the importa and Organisation to Marketing and Innovation, and a			
	 explain the differences between Economics important definitions from the field of Manage explain the most important aspects of and g projects describe and explain basic business function organization and human ressource managem explain the relevance of planning and dec uncertainty, and explain some basic methods 	ement goals in Management and name the most ons as production, procurement and so ent, information management, innovation ision making in Business, esp. in situa from mathematical Finance	: important aspe ourcing, supply management ar	cts of entreprneu chain manageme id marketing
Skills	 state basics from accounting and costing and Students are able to analyse business units with res 	spect to different criteria (organization, ob	jectives, strateg	ies etc.) and to ca
	out an Entrepreneurship project in a team. In particu	liar, they are able to		
	 analyse Management goals and structure the 	m appropriately		
	 analyse organisational and staff structures of 			
	 apply methods for decision making under multiple 		ıder risk	
	analyse production and procurement systems			
	analyse and apply basic methods of marketing			
	 select and apply basic methods from mathem apply basic methods from accounting, costing 			
	• apply basic methods norm accounting, costing	g 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 entrepreneurship project and write a co	herent report on	the project
	 to communicate appropriately and 			
	 to cooperate respectfully with their fellow stud 	dents.		
Autonomy	Students are able to			
	 work in a team and to organize the team then 	nselves		
	 to write a report on their project. 			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points				
Course achievement				
	Subject theoretical and practical work			
	several written exams during the semester			
scale	set and matter example and gring the settlester			
	General Engineering Science (German program, 7 se	emester): Core Qualification: Compulsory		
Following Curricula				
Ū.	Civil- and Environmental Engineering: Specialisation		sory	
	Civil- and Environmental Engineering: Specialisation		5	
	Bioprocess Engineering: Core Qualification: Compuls	sory		
	Computer Science: Core Qualification: Compulsory			
	Data Science: Core Qualification: Compulsory			
	Electrical Engineering: Core Qualification: Compulsor	ry		
	Energy and Environmental Engineering: Core Qualifi			
	General Engineering Science (English program, 7 sei			
	General Engineering Science (English program, 7 ser			
	General Engineering Science (English program, 7 ser			-
	General Engineering Science (English program, 7 ser			ng: Compulsory
	General Engineering Science (English program, 7 sei	mester): Specialisation Computer Science	compulsory	
		7 comoctor), Enocialization Marthan	Engineerin	OCULC Diama
	General Engineering Science (English program,	7 semester): Specialisation Mechanical	Engineering, F	ocus Biomechan
	General Engineering Science (English program, Compulsory			
	General Engineering Science (English program, Compulsory General Engineering Science (English program, 7			
	General Engineering Science (English program, Compulsory	semester): Specialisation Mechanical E	ngineering, Foc	us Energy Syster

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
Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory
Computational Science and Engineering: Core Qualification: Compulsory
Logistics and Mobility: Core Qualification: Compulsory
Mechanical Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Orientation Studies: Core Qualification: Elective Compulsory
Orientation Studies: Core Qualification: Elective Compulsory
Naval Architecture: Core Qualification: Compulsory
Technomathematics: Core Qualification: Compulsory
Process Engineering: Core Qualification: Compulsory
Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L08	82: Management Tutorial
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload	Independent Study Time 62, Study Time in Lecture 28
in Hours	
Lecturer	Prof. Christoph Ihl, Katharina Roedelius
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 busin- knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction t	to 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. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Kathrin Fischer, Prof. Matthias Meyer,
	Prof. Thomas Wrona, Prof. Thorsten Blecker, Prof. Wolfgang Kersten
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, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and 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. Aufl., Stuttgart 2005.
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Courses				
Title		Тур	Hrs/wk	СР
Advanced Intenship AIW/ ES: Inter	nship-accompanying Seminar (L2687)	Seminar	1	0
Advanced Internship AIW/ ES: Prep	aration (L2682)	Seminar	1	0
Module Responsible	Prof. Robert Seifried			
Admission Requirements	None			
Recommended Previous	150 Creditpoints in General Engineering Scien	ce		
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	Students of the different specialisations get ex	operiences in typical scope of duties of	engineers, who are worki	ing in a developme
	division, planning division or in the manage	ement of a company. In the framewo	ork of this environment	the knowledge fro
	university can used a first time for real engine	eering tasks.		
Skille	Students of the different specialisations should	uld be integrated in typical day's wor	Ry this they are learning	ing typical tasks a
JKIIIS	functions of engineers. They are able to struct			
Personal Competence				
Social Competence	Students are able to cooperate with co-worker	rs in a company and to understand the	language of engineers.	
Autonomy	Students can finish own tasks.			
Autonomy	Students can inisi own tasks.			
Workload in Hours	Independent Study Time 512, Study Time in L	ecture 28		
Credit points	18			
Course achievement	None	None		
Examination	Written elaboration (accord. to Internship Reg	ulations)		
Examination duration and	see Internship Regulations			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Core Qualification: Con	npulsory	

Course L2687: Advanced Intenship AIW/ ES: Internship-accompanying Seminar

Тур	Seminar
Hrs/wk	1
CP	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
Content	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 internship sof their ports the acquisition and consolidation of competences in career management skills that can be transferred to later career steps.
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.

-				
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	1	Lecture	2	2
	Prof. Frank Schmidt-Döhl			
Admission Requirements				
	Knowledge of physics, chemistry and m	nathematics from school		
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	The students are able to identify fundation	mental effects of action to materials and structures, to	explain different	t types of mechanic
	behaviour, to describe the structure	of building materials and the correlations between	structure and	other properties,
	show methods of joining and of corros	sion processes and to describe the most important re	egularities and p	properties of building
	materials and structures and their mea	surement in the field of protection against moisture, co	oldness, fire and	noise.
Chille	The students are able to work with the	a meet important standardized methods and regulariti	an in the field of	na alatura muata atia
SKIIIS		e most important standardized methods and regulariti		moisture protection
	the German regulation for energy saving	ng, fire protection and noise protection in the case of a	small building.	
Personal Competence				
Social Competence	The students are able to support each o	other to learn the very extensive specialist knowledge.		
Autonomy	The students are able to make the timin	ng and the operation steps to learn the specialist know	ledge of a very e	extensive field.
Workload in Hours	Independent Study Time 96, Study Tim	e in Lecture 84		
Credit points				
Course achievement	None			
	Written exam			
Examination duration and	2 h written exam			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Civil Engineering:	Compulsory	
Following Curricula	Civil- and Environmental Engineering: C	Core Qualification: Compulsory		
	General Engineering Science (English p	rogram, 7 semester): Specialisation Civil Engineering:	Compulsory	
	Orientierungsstudium: Core Qualification	on: Elective Compulsory		
	Technomathematics: Specialisation III	Engineering Science: Elective Compulsory		

Course L0217: Building Phys	ics
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 Physics		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Course L0215: Principles of E	Building Materials
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	Structure of building materials
	Effects of action
	Fundamentals of mechanical behaviour
	Material testing
	Principles of metals
	Joining methods
Literature	Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3
	Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8

Courses					
Title			Тур	Hrs/wk	СР
Structural Analysis I (L0666)			Lecture	2	3
Structural Analysis I (L0667)			Recitation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek				
Admission Requirements	None				
Recommended Previous	Mechanics I, Mather	matics I			
Knowledge					
Educational Objectives	After taking part suc	ccessfully, students have re	eached the following learning results		
Professional Competence					
Knowledge	After successfully co	ompleting this module, stud	lents can express the basic aspects of line	ar frame analysis of	statically determina
	systems.				
Skille	After successful con	polation of this module, th	e students are able to distinguish between	statically dotormina	ato and indotormina
JKIIIS			riables and to construct influence lines of	-	
	frame and truss stru	-		statically acterinin	are plane and space
Personal Competence					
Social Competence					
		subject-specific and interd			
	 defend their own work results in front of others promote the scientific development of colleagues Furthermore, they can give and accept professional constructive criticism 				
	• Turthermore,	they can give and accept			
Autonomy	The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the				
	learning progress du	uring the lecture period, all	eady.		
Workload in Hours	Independent Study	Time 124, Study Time in Le	ecture 56		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	No 10 %	Written elaboration	Hausübungen mit Testat, betreut durc	h Studentische Tuto	oren (Tutorium)
Examination	Written exam				
Examination duration and	90 Minuten				
scale					
Assignment for the	General Engineering	g Science (German progran	n, 7 semester): Specialisation Civil Enginee	ring: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory				
	Civil- and Environmental Engineering: Core Qualification: Compulsory				
	Civil- and Environmental Engineering: Core Qualification: Compulsory				
			, 7 semester): Specialisation Civil Engineer	ing: Compulsory	
			ering Science: Elective Compulsory		
	rechnomathematics	s: specialisation III. Enginee	ring Science: Elective Compulsory		
Course L0666: Structural An	alveie I				
	Lecture				
Typ Hrs/wk	2				
Hrs/wk	۷				

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

Courses						
Title				Тур	Hrs/wk	СР
Building Materials and Building Che	emistry (L0248)			Lecture	4	4
Building Materials and Building Che	emistry (L0249)			Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-	Döhl				
Admission Requirements	None					
Recommended Previous	Module Principles of	Building Material	s and Building Physics			
Knowledge						
Educational Objectives	After taking part suc	cessfully, student	ts have reached the foll	owing learning results		
Professional Competence						
Knowledge	The students are a	able to explain	the most important of	components, the manufacture	, the structure,	the most importa
	characteristics of the	e mechanical be	haviour and the corros	on behaviour, the material te	sting and the field	s of utilization of
	relevant building ma	terials.				
	-					
Skille	The students are al	blo to accoss the	o usability of building	matorials for different applica	tions and to solo	t building matori
SKIIIS	The students are able to assess the usability of building materials for different applications and to select building material according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concr					
		-	-			
				nd the connections between t	ne characteristic c	oncrete paramete
	They are able to sele	ect suitable mater	rials and mixtures to av	bid damage processes.		
Personal Competence						
Social Competence	The students are ab	le to support eac	h other to learn the ve	ry extensive specialist knowled	lae in learnina aro	ups and to carry o
	exercises in small gr				5 55	
	,					
Autonom	The students are abl	a ta malia tha tin	aina and the energtion (tens to leave the energialist line		utonoise field
Autonomy	The students are abi	e to make the tin	ning and the operation s	steps to learn the specialist kno	wiedge of a very e	extensive field.
Workload in Hours	Independent Study T	ime 110, Study T	Fime in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	No 10 %	Presentation				
Examination	Written exam					
Examination duration and	2 h written exam					
scale						
Assignment for the	General Engineering	Science (Germar	n program, 7 semester):	Specialisation Civil Engineerin	g: Compulsory	
-			: Core Qualification: Con		_ ,,	
				Specialisation Civil Engineering	: Compulsory	

Course L0248: Building Mate	rials and Building Chemistry
Тур	Lecture
Hrs/wk	4
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 Materials and Building Chemistry		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl, Andre Rössler	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

ourses						
itle			Тур	Hrs/wk	СР	
roject Seminar Concrete I (L0896)			Seminar	1	1	
Reinforced Concrete Design I (L030	3)		Lecture	2	3	
Reinforced Concrete Design I (L030	15)		Recitation Section (large	2	2	
Module Responsible	Prof. Günter Romba	ch				
Admission Requirements	None					
Recommended Previous	Basic knowledge in	structural analysis and	l building materials.			
Knowledge	Modules: Structura	l Analysis I, Mechanics	1+11			
Educational Objectives	After taking part su	ccessfully, students ha	ve reached the following learning results			
Professional Competence						
Knowledge	The students can ou	utline the history of co	ncrete construction and explain the basics of	structural engineering	, including usual lo	
	combinations and s	afety concepts. They a	are able to draft and dimension simple struct	ures, as well as to eva	luate and discuss	
	behaviour of the ma	aterials and of structura	al members.			
Skills The students are able to apply basic procedures of the conception and dimensioning to p						
	simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and					
	execution. Moreove	r, they can make desig	in and construction sketches and draw up tec	hnical descriptions.		
Personal Competence						
Social Competence						
Autonomy	The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the result					
Workload in Hours	Independent Study	Time 110, Study Time	in Lecture 70			
Credit points						
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Excercises				
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	General Engineering	g Science (German pro	gram, 7 semester): Specialisation Civil Engine	ering: Compulsory		
Following Curricula	Civil- and Environm	ental Engineering: Core	e Qualification: Compulsory			
	1					

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

Course L0303: Reinforced Co	ncrete Design I
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	The following subjects/contents are treated:
Literature	 history of concrete construction building materials: mechanical and physical-chemical properties of concrete, steel, GFRP, CFRP Introduction in safety concepts, ultimate limit states and safety coefficients actions on structures design of linear concrete members with arbitrary cross section for tension and bending with/without axial force design of slender columns 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

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

Module M0744: Struc	tural Analysis II					
Courses						
Title			Тур		Hrs/wk	СР
Structural Analysis II (L0673)			Lectur		2	3
Structural Analysis II (L0674)			Recita	tion Section (large)	2	3
Module Responsible	Prof. Uwe Starossek					
Admission Requirements Recommended Previous	None					
Knowledge	Mechanics I/II					
	Mathematics I/II					
	 Differential Equations I Structural Analysis I 					
Educational Objectives	After taking part successfully,	, students have re	ached the following lear	ning results		
Professional Competence						
Knowledge	After successful completion	of this module,	students can express	the basic aspects of	of linear frame a	nalysis of statica
	indeterminate systems.					
Skille	After successful completion (of this module th	e students are able to	analyze state variable	es and to constru	ct influence lines
Skills	statically inderminate plane a					ct initidence inies
Personal Competence						
Social Competence	Students can					
	 participate in subject-s defend their own work 					
	 promote the scientific 					
	 Furthermore, they can 			criticism		
Autonomi	The students are able to your	li in torra horsoura	ul acciente Due te	the is taken feedback	they are enchied	d to colf occord th
Autonomy	The students are able to wor learning progress during the l			the in-term reedback	, they are enabled	a to sen-assess th
	rearing progress during the	lecture period, une	cuuy.			
Workload in Hours	Independent Study Time 124,	, Study Time in Le	cture 56			
Credit points	6					
Course achievement	Compulsory Bonus Form	n elebersti	Description	antat haturut dunit C	hudenbiech - Tot	en (Tuterium)
Examination		n elaboration	nausubungen mit Te	estat, betreut durch S	ludentische Tutor	en (Tutorium)
Examination Examination duration and	90 Minuten					
scale						
Assignment for the	General Engineering Science	(German program	, 7 semester): Specialisa	ation Civil Engineering	: Compulsory	
Following Curricula	Civil- and Environmental Engi	neering: Core Qua	lification: Compulsory			
	General Engineering Science	(English program,	7 semester): Specialisat	tion Civil Engineering:	Compulsory	
Course L0673: Structural An						
Тур	Lecture					
Hrs/wk						
CP Workload in Hours	3 Independent Study Time 62, 5	Study Time in Last	ure 28			
	Prof. Uwe Starossek	Judy Time In Lect	.ure 20			
Language						
Cuclo						

Laliguage	
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 Ana	ourse 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 M0706: Geote	echnics I			
Courses				
Title		Тур	Hrs/wk	СР
Soil Mechanics (L0550)		Lecture	2	2
Soil Mechanics (L0551)		Recitation Section (large)	2	2
Soil Mechanics (L1493)	1	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 reached the following learning results		
Professional Competence				
Knowledge	The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, wate			
	or structures, consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure. After the successful completion of the module the students should be able to describe the mechanical properties and to evalu them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weigh			ailure.
Skills				rties and to evaluate
				oils due to weight
	influence of structures. They are are ab	le to prove the usability (settlements) for shallow f	oundations.	
Deveral Competence				
Personal Competence				
Social Competence				
Autonomy	Independent Study Time 96, Study Tim	a in Lastura 94		
		e in Lecture 84		
Credit points Course achievement		Description		
Course achievement	No 20 % Attestation	Description		
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Civil Engineer	ina: Compulsory	
-		program, 7 semester): Specialisation Civil Engineer		
	Civil- and Environmental Engineering: C		5	
	Civil- and Environmental Engineering: C			
		rogram, 7 semester): Specialisation Civil Engineeri	ng: Compulsory	
	5 5 . 5 1	Engineering Science: Elective Compulsory		
		Engineering Science: Elective Compulsory		

Course L0550: Soil Mechanic	S
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	WiSe/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

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

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

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				
Knowledge	Structural analysis I, Structural analysis II			
	Mechanics I, Mechanics II Duilding Materials and Building Chamintan			
	Building Materials and Building Chemistry			
	 Principles of Building Materials and Buildir 	ig Physics		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	After passing this module students are able to			
	 give a summary of the security concept 			
	 explain the priciples of the design process 			
	 describe and illustrate the bhaviour of me 			
<i>ci 11</i>				
SKIIIS	Students can rate and apply the material steel appropiately with respect to its properties and usage.			
	They can use the security concept with respect t	o loads, forces and resistances.		
	They can check the ultimate limit state and the	serviceability of simple members in tension,	compression and	bending.
Personal Competence				
Social Competence	After participation of an optional course (buildin	g of a simple truss) they are able to organi	ze themselves in	groups. They will
	successful in guided building a truss with bolted	connections according to design drawings.		
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Civil Engineering	: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Core Qual	ification: Compulsory		
	General Engineering Science (English program, 7	r semester): Specialisation Civil Engineering:	Compulsory	
Course L0299: Steel Structu	res I			
Тур	Lecture			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lectu	ıre 28		

Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	rof. Marcus Rutner	
Language		
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			
Fitle	Тур	Hrs/wk	СР
Applied Structural Dynamics (L079)		2	2
Soil Laboratory Course (L0499)	Practical Course	1	2
Building Information Modeling (L190		1	1
Building Information Modeling (L190		2	2
Computational Analysis of Structure		2	3
ntroduction in Statitics with R (L02		1	1
ntroduction in Statitics with R (L07	-	1	1
rinciples of Geomatics (L0470)	Lecture	2	2
rinciples of Geomatics (L0471)	Recitation Section (small)	2	2
lumeric 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 Environn		1	1
Special topics of Civil- and Environn	nental Engineering 2 LP (L2412)	2	2
Special topics of Civil- and Environn	nental Engineering 3LP (L2413)	3	3
ire Protection and Prevention (L04	72) Lecture	2	2
Module Responsible	Prof. Peter Fröhle		
Admission Requirements	None		
Recommended Previous	none		
Knowledge			
Educational Objection			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Educational Objectives Professional Competence	After taking part successfully, students have reached the following learning results		
Professional Competence	After taking part successfully, students have reached the following learning results The students are at home doing with typical applications of the study programme.		
Professional Competence Knowledge		stions. They a	re able to work in
Professional Competence Knowledge Skills Personal Competence	The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical ques learnt methods into new forms of application independently".		
Professional Competence Knowledge Skills Personal Competence	The students are able to use the methods that are provided during the lectures for practical ques		
Professional Competence Knowledge Skills Personal Competence Social Competence	The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical ques learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i	n teams. If s	o, they can prese
Professional Competence Knowledge Skills Personal Competence Social Competence Autonomy	The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical ques learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly.	n teams. If s	o, they can prese
Professional Competence Knowledge Skills Personal Competence Social Competence Autonomy	The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical quess learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly. According to the course chosen individual students can plan and document tasks and work flow f Depends on choice of courses	n teams. If s	o, they can pres
Professional Competence Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Credit points	The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical quess learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly. According to the course chosen individual students can plan and document tasks and work flow f Depends on choice of courses	n teams. If s for themselve	o, they can pres s or for the team.

Course L0791: Applied Struc	tural Dynamics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	15 min
scale	
	Dr. Kira Holtzendorff
Language	
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 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 Inform	nation 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
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
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
CP	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	DE
Cycle	WiSe
Content	 basics of the Finite Element Method, Spreadsheets basics of software 'SOFISTIK' modeling of an arbitrary cross-section modeling of an arbitrary 2D truss structure incl. loads Teddy: usage of global and local variables design of a concrete section modeling of a T-beam bridge by means of a grillage system modeling and design of a rectangular slab building models
Literature	 Vorlesungsunterlagen können im STUDiP heruntergeladen werden Tutorials von SOFiSTiK Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &.Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau 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	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	Dr. Annette Scheider
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0125: Numeric and I	
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	Dr. Stefan Benders, Prof. Siegfried Rump
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

ourse 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 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	Shahin Daniel Fassih, 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	

Courses							
Title					Tun	Hrs/wk	CP
Hydrology (L0909)					Typ Lecture	пт 5/ wк 1	1
Hydrology (L0956)					Project-/problem-based Learning	1	2
Hydromechanics (L0615)					Lecture	2	2
Hydromechanics (L0616)					Project-/problem-based Learning	1	1
Module Responsible	Prof. Peter Fr	öhle					
Admission Requirements	None						
Recommended Previous	Mathematics	I, II and II	1				
Knowledge							
	Mechanics I u	und II					
Educational Objectives	After taking p	oart succe	ssfully, students have r	eached the following	g learning results		
Professional Competence							
Knowledge	The students	are able	to define the basic ter	ms of hvdromecha	nics, hydrology groundwater h	vdrology and	water manageme
2					ii) kinematics of flows and iii)		
	-				cycle. Besides, the students		
					models as well as the concep		
	hydrograph.		5				
	J 5 - 1-						
Skills	The students	are able	to apply the fundament	al formulations of hy	ydromechanics to basic practic	al problems. F	urthermore, they a
	able to run, explain and document basic hydraulic experiments.						
	Pacidae, they are able to apply basic hydrological approaches and wathede to simple hydrological mediants. The students have						
	Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students hav						
	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 des				can be descri	bed and the studer	
	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 plenary sessions by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentation						
				loaches. Turthennoi		iu present tet	
	for given topi	ics in grou	ips.				
Autonomy	Students are	capable o	of organising their indivi	dual work flow to co	ontribute to the conduct of exp	eriments and	to present disciplir
	specific know	vledge. Th	ney can provide each o	ther with feedback	and suggestions on their resu	lts. They are	capable of reflecti
	their study techniques and learning strategy on an individual basis.						
Workload in Hours	Indonondont	Independent Study Time 110, Study Time in Lecture 70					
Credit points		Study III	ie 110, Study fille if E				
Course achievement	Compulsory B	onus	Form	Description			
	Yes N	lone	Group discussion	Erstellung eir	ne Posters zu einer Themat	tik aus dem	Themengebiet o
				Hydrologie in (Gruppen und Präsentation		-
	Yes N	lone	Excercises	Übungsaufgab	en Hydrologie		
		lone	Subject theoretical		Dokumentation und Prä	sentation zu	ı einem Versuc
			practical work		ik oder Hydraulik in Gruppen		
Examination	Written exam	า					
Examination duration and	150 minutes						
scale							
Assignment for the	General Engi	neering S	cience (German prograr	n, 7 semester): Spe	cialisation Civil Engineering: Co	ompulsory	
Following Curricula	Civil- and Env	vironment	al Engineering: Core Qu	alification: Compuls	sory		
	General Engi	neering S	cience (English program	, 7 semester): Spec	ialisation Civil Engineering: Co	mpulsory	
	Logistics and	Mobility:	Specialisation Traffic Pla	anning and Systems	Elective Compulsory		
	-	-	gement - Major in Logisl				

Course L0909: Hydrology	
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of hydrology 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	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of Hydrology: • Hydrological cycle • Data acquisition • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde

Courses LOCIE: Understress	
Course L0615: Hydromechan	
	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	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: Hydromechan	urse L0616: Hydromechanics		
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	See interlocking course		
Literature	See interlocking course		

Module M0755: Geote	chnics II					
Courses						
Title				Тур	Hrs/wk	СР
Foundation Engineering (L0552)				Lecture	2	2
Foundation Engineering (L0553)				Recitation Section (large)	2	2
Foundation Engineering (L1494)				Recitation Section (small)	2	2
-	Prof. Jürgen Grabe					
•	None					
	Modules:					
Knowledge	 Mechanics I-II 					
	Geotechnics I					
	• Geotechnics i					
Educational Objectives	After taking part succ	ossfully students	have reached the follow	ing loarning rocults		
Professional Competence	Anter taking part succe	essiuny, students		ing learning results		
-	The students know the	o basis principlos	and mothods which are	required to verificate the stab	ility of gootochni	cal structures
-					inty of geotecrific	cal structures.
SKIIIS	After successful comp	letion of the modi	le the students are able	e to:		
	 verificate the st 	tability and usabili	ty of foundations,			
	 know individual 	l methods of groui	nd improvement and ap	ply them in their range of app	lication,	
	design retaining walls.					
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Tir	me 96, Study Time	e in Lecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	No 20 %	Attestation				
	Written exam					
Examination duration and	60 minutes					
scale						
Assignment for the	General Engineering S	cience (German p	rogram, 7 semester): S	pecialisation Civil Engineering	: Elective Compul	lsory
Following Curricula	General Engineering S	cience (German p	rogram, 7 semester): S	pecialisation Civil Engineering	: Elective Compul	lsory
	Civil- and Environmen	tal Engineering: C	ore Qualification: Comp	ulsory		
	Civil- and Environmen	tal Engineering: S	pecialisation Civil Engine	eering: Compulsory		
	Civil- and Environmen	tal Engineering: S	pecialisation Traffic and	Mobility: Elective Compulsory	/	
	Civil- and Environmen	tal Engineering: S	pecialisation Water and	Environment: Elective Compu	llsory	
	General Engineering S	cience (English p	ogram, 7 semester): Sp	ecialisation Civil Engineering:	Elective Compuls	sory
	Technomathematics:	Consisting III.		ative Commuterer		

Course L0552: Foundation E	ngineering
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	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

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	Ту	p	Hrs/wk	СР		
Basics in Structural Design (L0209)		ject-/problem-based Learning	2	4		
Basics of Structural Design (L0205)		cture	2	1		
Basics in Structural Design (L0208)		citation Section (large)	1	1		
Module Responsible						
Admission Requirements	None					
Recommended Previous	Contents of module "Principles of Building Materials and Building Phy	ysics"				
Knowledge						
	After taking part successfully, students have reached the following le	earning results				
Professional Competence						
Knowledge	After attending the "Building Construction" module students are able	e				
	 to define the basics of building regulations law 					
	 to explain load effects and associated concepts 					
	 to describe overriding conventions of the construction industr 	Ty				
	 to specify typical building components 					
	• to distinguish between different possibilities of load bearing b	ehaviour and risks due to lac	k of stability			
	 to explain the main objective 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 compone 	ents				
	 develop stability and foundation concepts 					
use BIM software						
	 and to design and construct standard cross-sections due to structural aspects. 					
	-					
Personal Competence						
Social 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 results					
	 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 	kly presentations (locture rec	m) and tosts			
	 to divide the main task in different parts, to deduce the needed 	ed knowledge and to schedul	e the differen	t work steps		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points						
Course achievement						
Examination	Subject theoretical and practical work					
Examination duration and	Desing, Construction and prelimnary design in a written form					
scale	besing, construction and preliminary design in a written form					
Assignment for the	General Engineering Science (German program, 7 semester): Specia	lisation Civil Engineering: Co	mpulsorv			
Following Curricula	Civil- and Environmental Engineering: Core Qualification: Compulsor					
	General Engineering Science (English program, 7 semester): Special	-				

ourse L0209: Basics in Stru	ctural Design
Тур	Project-/problem-based Learning
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Sebastian Rybczynski
Language	DE
Cycle	WiSe
Content	 Constructing a small individual building in groups of 4 percent.
	 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 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
	Lach week the results of unrefer 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
	Norford Frank (City Laborator)
	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, Bauherrr
	Lehrenden und Lernenden
	ISBN: 978-3-8348-0732-8 (GB.)
	Wiesbaden : Vieweg + Teubner, 2009

Course L0205: Basics of Stru	ctural Design
Тур	
Hrs/wk	
CP	
	Independent Study Time 2, Study Time in Lecture 28
	Sebastian Rybczynski
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
	Schneider Bautabellen (Hrsg. A. Albert)
	23., überarbeitete Aufl.
	ISBN 978-3-8462-0880-9
	Reguvis Fachmedien GmbH, 2018
	Neumann, Dietrich (Hestermann, U.; Rongen, L.; Weinbrenner, U.)
	Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource]
	ISBN: 978-3-8351-9121-1
	Wiesbaden: Vieweg+Teubner Verlag, 2006
	Frick, Otto (Knöll, K.; Neumann, D.; Hestermann, U.; Rongen, L.)
	Baukonstruktionslehre 2 / [Internet-Ressource]
	ISBN: 978-3-8348-9486-1
	Wiesbaden: Vieweg+Teubner Verlag, 2008
	Dierks, Klaus (Wormuth, R.)
	Baukonstruktion
	ISBN: 978-3-8041-5045-4
	Neuwied : Werner, 2007
	Neufert, Ernst (Kister, J.)
	Bauentwurfslehre (42. Aufl.)
	ISBN: 978-3-8348-0732-8
	Wiesbaden : Vieweg + Teubner, 2018
	Wendehorst, Reinhard (Wetzell, O. W.,; Baumgartner, H.,)
	Wendehorst Bautechnische Zahlentafeln
	ISBN: 978-3-8351-0055-8
	Stuttgart/Berlin: Teubner/Beuth, 2018

rse L0208: Basics in Struc	ctural Design
	Recitation Section (large)
Hrs/wk	
СР	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sebastian Rybczynski
Language	DE
Cycle	WiSe
Content	Constructing a small individual building in groups of 4 percents
	 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 and express of the functionality of the component interconnections
	Design and approve of the functionality of the component interconnections Design and approve af maintum behaviour approximation accustic protection and five control
	 Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control
	Assessing the building stability
	Basics of building services Tech work the new the of eliferational effects are an encoded in and within 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, Däche
	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 f
	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
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauher
	Lehrenden und Lernenden
	ISBN: 978-3-8348-0732-8 (GB.)
	Wiesbaden : Vieweg + Teubner, 2009

Courses					
Title			Тур	Hrs/wk	СР
Project Concrete Structures II (L08	94)		Project Seminar	1	1
Concrete Structures II (L0348)			Lecture	2	3
Concrete Structures II (L0349)			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Romba	ch			
Admission Requirements	None				
Recommended Previous	• Knowlodgo o	floads on structures an	d combination of actions		
Knowledge	-		d combination of actions		
		ety format are required.			
	-	-	olumns for ultimate limit state		
	 Modules: Rel 	niorcea concrete struct	ures I, Structural Analysis I+II, Mechanics I+II		
	After taking part su	ccessfully, students hav	e reached the following learning results		
Professional Competence					
Knowledge			nich are required for design of reinforced cor	ncrete structures. Th	ney know the variou
	methods to estimat	e the member forces in	simple one and two-way slabs.		
Skills	 The students 	s can design reinforced	concrete structure in the ultimate limit st	ate (shear, bending	torsion) and in th
		-	leflection control) including detailing (anchora	-	,,
	-		per forces of simple slabs.	g = = · · · = · · · · · = · = · · · / ·	
			he layout of a structural analysis		
Personal Competence					
Social Competence	Cooperation in a pr	oject work, where they o	lesign in a team a real concrete building and p	present the results at	the end.
Autonomy					
Workload in Hours	Independent Study	Time 110, Study Time ii	n Lecture 70		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	Yes None	Excercises			
	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	General Engineerin	g Science (German prog	ram, 7 semester): Specialisation Civil Enginee	ring: Elective Compu	llsory
Following Curricula	General Engineerin	g Science (German prog	ram, 7 semester): Specialisation Civil Enginee	ring: Elective Compu	llsory
	Civil- and Environm	ental Engineering: Core	Qualification: Compulsory		
	Civil- and Environm	ental Engineering: Spec	ialisation Civil Engineering: Compulsory		
	Civil- and Environm	ental Engineering: Spec	ialisation Traffic and Mobility: Elective Compul	sory	
	Civil- and Environm	ental Engineering: Spec	ialisation Water and Environment: Elective Co	mpulsory	
	General Engineering	a Science (English progr	am, 7 semester): Specialisation Civil Engineer	ina: Elective Compul	sorv

Course L0894: Project Concr	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 Stru	ourse 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	

Module M0730: Comp	, ,				
Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L0321) Computer Engineering (L0324)			Lecture Recitation Section (small)	3 1	4 2
Module Responsible	Prof Heiko Falk		Recitation Section (Smail)	1	2
Admission Requirements	None				
	Basic knowledge in electrical er	ngineering			
Knowledge		5 5			
Educational Objectives	After taking part successfully, s	tudents have reached the foll	owing learning results		
Professional Competence					
Knowledge	This module deals with the fou programming down to gates. The Introduction			ers the layers fron	n the assembly-le
	 Combinational logic: Gat Sequential logic: Flip-flog Technological foundation Computer arithmetic: Int 	os, automata, systematic hard Is eger addition, subtraction, mu	-		works
	-	rchies, SRAM, DRAM, caches e perspective of the CPU, prim	ciples of passing data, point-to-	point connections,	busses
Skills	The students perceive compute composition of computer system collection of few and simple co today's computing systems - fru After successful completion of system and the software exect on the hardware-centric abstra the impact that these low abstr	ms. The students can analyze, imponents. They are able to come gates and circuits up to co the module, the students are ted on it. In particular, they s ction layers from the assembl	how highly specific and individ distinguish between and to exp mplete processors. a able to judge the interdepen hall understand the consequent y language down to gates. This	dual computers can blain the different indencies between inces that the exect s way, they will be	n be built based of abstraction layer a physical compu- ution of software enabled to evalu
	the impact that these low abstr		e system s performance and to	propose reasible c	iptions.
Personal Competence					
Social Competence	Students are able to solve simil	ar problems alone or in a grou	p and to present the results ac	cordingly.	
Autonomy	Students are able to acquire ne	w knowledge from specific lite	rature and to associate this kn	owledge with othe	r classes.
Workload in Hours	Independent Study Time 124, S	tudy Time in Lecture 56			
Credit points	6				
Course achievement	Compulsory Bonus Form Yes 10 % Excercis	Description			
Examination	Written exam				
Examination duration and	90 minutes, contents of course	and labs			
scale					
Assignment for the	General Engineering Science (G	erman program, 7 semester):	Specialisation Computer Scien	ce: Compulsory	
Following Curricula	General Engineering Science (G	erman program, 7 semester):	Specialisation Civil Engineering	g: Compulsory	
	General Engineering Science (G	erman program, 7 semester):	Specialisation Process Enginee	ering: Compulsory	
	General Engineering Science	(German program, 7 seme	ster): Specialisation Mechanic	cal Engineering, I	ocus Mechatron
		(C			
	Compulsory	(German program, / semest		- · · -	
	General Engineering Science		er): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	General Engineering Science Engineering: Compulsory				
	General Engineering Science				
	General Engineering Science Engineering: Compulsory General Engineering Science (C	ierman program, 7 semester)	Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechan
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls	erman program, 7 semester) (German program, 7 seme ory	Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechan Focus Materials
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C	erman program, 7 semester) (German program, 7 seme ory	Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechan Focus Materials
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls	ierman program, 7 semester) (German program, 7 seme ory German program, 7 semester,	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En	ineering, Focus Th ical Engineering, gineering, Focus P	eoretical Mechan Focus Materials roduct Developm
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory	ierman program, 7 semester) (German program, 7 seme ory German program, 7 semester, (German program, 7 semest	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc	eoretical Mechan Focus Materials roduct Developm us Energy System
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory	German program, 7 semester) (German program, 7 seme ory German program, 7 semester (German program, 7 semest (German program, 7 semest	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanica	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, F	eoretical Mechan Focus Materials roduct Developm us Energy System
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science (C	German program, 7 semester) (German program, 7 seme ory German program, 7 semester; (German program, 7 semest (German program, 7 semester):	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanica Specialisation Naval Architectu	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, F ure: Compulsory	eoretical Mechan Focus Materials roduct Developm us Energy Syste ocus Biomechan
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory	German program, 7 semester) (German program, 7 seme ory German program, 7 semester; (German program, 7 semest (German program, 7 semester): German program, 7 semester):	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanic Specialisation Naval Architectu Specialisation Biomedical Engi	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulso	eoretical Mechan Focus Materials roduct Developm us Energy Syste ocus Biomechan
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C	German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester): German program, 7 semester): German program, 7 semester): German program, 7 semester):	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory	eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C)	German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester): German program, 7 semester): German program, 7 semester): German program, 7 semester):	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory	eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C	German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester): German program, 7 semester):	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory	eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C	German program, 7 semester) (German program, 7 seme ory German program, 7 semester, (German program, 7 semest (German program, 7 semester): German program, 7 semester):	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory	eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C Compulsory Computer Science: Core Qualification Electrical Engineering: Core Qu	German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester) German program, 7 semester) Ger	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engi Specialisation Bioprocess Engi Specialisation Electrical Enging Specialisation Green Technolo	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc cal Engineering, Focus neering: Compulsory gies, Focus Renew	eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (E General Engineering Science (E)	German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester) (German program, 7 semester)	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engin Specialisation Bioprocess Engi Specialisation Electrical Engine Specialisation Green Technolo	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew	eoretical Mechan Focus Materials roduct Developm us Energy Syste rocus Biomechan ory yry / able Energy: Elec
	General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C Compulsory Computer Science: Core Qualification Electrical Engineering: Core Qu General Engineering Science (E	German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semester) (Cation: Compulsory (Cation: Compulsory (Cation: Compulsory (Cation: Compulsory (Cation) (Compulsory (Cation) (Compulsory (Cation) (Compulsory (Cation) (Compulsory (Cation) (Compulsory (Cation) (Compulsory (Cation) (Compulsory (Cation) (Cation) (Cation	Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engin Specialisation Bioprocess Engi Specialisation Electrical Engine Specialisation Green Technolo	ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew :: Compulsory al Engineering, F	eoretical Mechan Focus Materials roduct Developm us Energy Syster rocus Biomechan ory ry dable Energy: Elec ocus Biomechan

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
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/EN
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	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/EN		
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	2	2
Groundwater Hydrology (L0252)		Recitation Section (large)	2	2
Water Management and Water Qua	lity (L0366)	Lecture	2	2
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Mathemaics I to III; Water Engineering I, 0	Chemistry		
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to define terms of the	hydrologic cycle and also parameters to identify	the water quality.	Typical aquifer type
	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			
				nysical background
	well hydraulics. Fundamentals of solute t	ransport can be reflected.		
Skills	Students are able to use fundamental relationships of hydrology and water management for the solution of practical issues.			practical issues. The
	are in a position to rate water quality d	ata and to set up hydrological water balances. Th	ney are able to co	nstruct ground wat
	contour lines and streamlines on the ba	sis of head data. They have the ability to analyse	data of hydraulic	field and lab tests
	determine hydraulic conductivities and storage coefficients.			
Personal Competence				
Social Competence	Students are able to help each other solv	ving case studies.		
Autonomy	Are not imparted in this module.			
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	ogram, 7 semester): Specialisation Civil Engineerin	ig: Elective Compu	lsory
Following Curricula	Civil- and Environmental Engineering: Co	re Qualification: Compulsory		
	Conoral Engineering Science (English pro	ogram, 7 semester): Specialisation Civil Engineering	. Flactive Commul	

Course L0251: Groundwater	Hydrology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
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	Course L0252: Groundwater Hydrology		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Hannes Nevermann		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0366: Water Manag	ement and Water Quality
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Mathias Ernst
Language	DE
Cycle	WiSe
Content	 The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview: Water balance, water availability, water scarcity, water recycling Water quality parameter (organic, inorganic), assessment and decision support tools.
Literature	 Teil Wasserwirtschaft: Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001 Wasser; Grohmann, Andreas N Berlin [u.a.]: de Gruyter, 2011 Pdf der Vorlesung

Courses					
Title		Тур	Hrs/wk	СР	
Nastewater Disposal (L0276)		Lecture	2	2	
Wastewater Disposal (L0278)		Recitation Section (large)	1	1	
Drinking Water Supply (L0306)		Lecture	2	1	
Drinking Water Supply (L0308)		Recitation Section (large)	1	2	
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
Recommended Previous	 Basic knowledge on Chemistry and Biol 	ogy			
Knowledge					
	Hydraulics of pipe systems and open ch				
	Basic knowledge on water managemen				
	Basic knowledge on Environmental Leg	Islation: Federal Water Act			
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge	The students can examplify their expert know	vledge on urban water infrastructures. They o	an present the de	erivation and detail	
	explanation of important standards for the de	sign of drinking water supply and wastewater	disposal systems	in Germany and th	
	are capable of reproducing the relevant empi	ricals assumptions and scientific simplifcation	s. The students ar	e able to present a	
	discuss sanitary engineering processes and t	he technologies used for drinking and waste	water treatment.	They can also asse	
	existing problems in the field of sanitary engine			-	
	draft the features and effectiveness of impor				
	systems and techniques for the removal of tra		and for pressure		
	systems and teeningues for the removal of the	lee pondunes.			
Skille	The students are able to apply the relevant s	tandards and guidelines for the design and o	neration of urban	water infrastructur	
34///3	s The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructure independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the				
	associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemica				
	problems in the filed of drinking water and		able to develop	ideas of their own	
	improve the existing water related infrastruct	ures, systems and concepts.			
Personal Competence					
	Social skills are not targeted in this module.				
Social competence	Social skins are not targeted in this module.				
Autonomy	Students are able to form concepts on their	own to optimize urban water infrastructure	processes. Theref	ore they can acqu	
	appropriate knowledge when being given so	me clues or information with regard to the a	pproach to proble	ems (preparation a	
	follow-up of the exercises).	5			
147	Independent Charles Times O.C. Ch. J. The Lat.	atura 94			
Workload in Hours Credit points	Independent Study Time 96, Study Time in Le 6	clure 84			
	None				
	Written exam				
Examination duration and					
scale	Conoral Engineering Science (Corman progra	n, 7 semester): Specialisation Civil Engineerin	g: Elective Compu	lsory	
scale Assignment for the	General Engineering Science (Gennan bround				
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Green Technolo	gies: Compulsorv		
Assignment for the	General Engineering Science (German program	•	gies: Compulsory	2	
Assignment for the	General Engineering Science (German program Civil- and Environmental Engineering: Core Qu	alification: Compulsory	gies: Compulsory		
Assignment for the	General Engineering Science (German program	ualification: Compulsory ualification: Compulsory			

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 Auf 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 Educal 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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0306: Drinking 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	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Klaus Johannsen, Prof. Mathias Ernst	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

	ulic Engineering					
Courses						
Fitle				Тур	Hrs/wk	СР
Hydraulics (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
Module Responsible	Prof. Peter Fröhle					
Admission Requirements	None					
Recommended Previous	Hydraulic Engineering I					
Knowledge						
Educational Objectives	After taking part successfully, s	tudents have r	eached the followin	g learning results		
Professional Competence						
Knowledge	Students are able to define the	basic terms	of hydraulic engine	ering and hydraulics. They are	able to expla	in the application
2				I hydraulic engineering probler		
				verview over river engineering		
	engineering and waterways eng				,	
Skills	The students are able to apply	hydraulic engi	neering methods a	nd approaches to basic practic	al problems a	nd design respect
	hydraulic engineering systems	Besides this,	they are able to us	e and apply established approa	aches of hydra	aulics and determ
	water surfaces of channel flows	, influences of	constructions (weir	s, etc.) on channel flows as well	as flow condi	tions of pipe syste
	Furthermore, they are able to r	ın, explain and	document basic hy	/draulic experiments.		
Personal Competence						
Social Competence	The students are able to deploy their gained knowledge in applied problems. Additionaly, they will be able to work in team wi					
	engineers of other disciplines	in a goal-oriei	ntated, structured	manner. They can explain thei	r results by u	use of peer learn
	approaches.					
Autonomy	The students will be able to ind	ependently ex	tend their knowledg	e and apply it to new problems	. Furthermore	, they are capable
	organising their individual work	flow to contrib	oute to the conduct	of experiments and to present	discipline-spec	cific knowledge.
Workload in Hours	Independent Study Time 110, S	tudy Time in L	ecture 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
	Yes None Subject		andDurchführung		sentation zu	einem Versu
	practica	work	Hydromechan	ik oder Hydraulik		
Examination	Written exam					
			The examination i	ncludes tasks with respect to	the general u	inderstanding of
scale	lecture contents and calculation					
Assignment for the				cialisation Civil Engineering: Ele	-	-
Following Curricula			m, 7 semester): Sp	ecialisation Green Technologies	s, Focus Water	r and Environmen
	Engineering: Elective Compulsory					
	Civil- and Environmental Engine	ering: Core Qu	alification: Compute	sory		
	General Engineering Science (E	nglish program	n, 7 semester): Spec	cialisation Civil Engineering: Ele	ctive Compuls	ory
	Green Technologies: Energy, W	ater, Climate:	Specialisation Wate	r: Elective Compulsory		
Course L0957: Hydraulics						
Тур	Lecture					
Hrs/wk	1					
СР	1					
Workload in Hours	Independent Study Time 16, St	udy Time in Le	cture 14			
Lecturer	Prof. Peter Fröhle					
Language	DE					
Cycle	WiSe/SoSe					
cycle						
Content	Flow of incompressible fluids in	pipes and ope	n channels			
	Flow of incompressible fluids in • Hydraulics of pipes	pipes and ope	n channels			

- Hydraulics of pipesPunps 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

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 Engir	neering and Material Engineerin	g	
Courses				
Title Introduction into Process Engineeri Fundamentals of material engineer		Typ Lecture Lecture	Hrs/wk 2 2	CP 1 2
Module Responsible	- Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning results		
Professional Competence				
Knowledge	After passing this module the student	ts have the ability to:		
		mportant fields on process and bioprocess engi s for different fields in process engineering.	neering,	
Skills	 name the most important work read and prepare an engineeri explain the most important teo 	tant fields of process engineering, king approaches or methods of the different fiel	ment	
Personal Competence Social Competence	The students are able to work out results in groups and provide appropriate feedback a 	document them, and handle feedback on their own performance	constructively.	
Autonomy	The students are able to estimate th Engineering and Bioprocess Engineer	neir progress of learning by themselves and to ing.	o deliberate their lack of k	nowledge in Proces
Workload in Hours	Independent Study Time 34, Study Ti	me in Lecture 56		
Credit points	3			
Course achievement		Description		
P	No 5 % Written elabor	ation		
Examination				
Examination duration and scale	90 min			
Assignment for the	Conoral Engineering Science (Corma	n program, 7 semester): Specialisation Process	Engineering: Compulsory	
Following Curricula		n program, 7 semester): Specialisation Process n program, 7 semester): Specialisation Bioproce		rv
g en reula	Bioprocess Engineering: Core Qualific			,
	1 5 5 1	program, 7 semester): Specialisation Bioproce	ss Engineering: Compulsor	У
		program, 7 semester): Specialisation Process I		
	Orientierungsstudium: Core Qualificat	tion: Elective Compulsory		
	Process Engineering: Core Qualification	on: Compulsory		

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

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

ourses				
ourses				
itle		Тур	Hrs/wk	СР
omputer Engineering (L0321)		Lecture Recitation Section (small)	3 1	4 2
omputer Engineering (L0324)	Dref Lielle Felle	Recitation Section (smail)	1	Z
Module Responsible	None			
Admission Requirements	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence		5 5		
	This module deals with the foundations of the function programming down to gates. The module includes the fo Introduction Combinational logic: Gates, Boolean algebra, Bool Sequential logic: Flip-flops, automata, systematic Technological foundations Computer arithmetic: Integer addition, subtraction Basics of computer architecture: Programming mo Memories: Memory hierarchies, SRAM, DRAM, cac Input/output: I/O from the perspective of the CPU, The students perceive computer systems from the architecture and a subtraction of computer systems. The students can ana	ellowing topics: lean functions, hardware synthesis, c hardware design n, multiplication and division odels, MIPS single-cycle architecture, hes principles of passing data, point-to-p tect's perspective, i.e., they identify ilyze, how highly specific and individ	ombinational net pipelining point connections, the internal struct ual computers car	works , busses ture and the phys n be built based o
	collection of few and simple components. They are able today's computing systems - from gates and circuits up the After successful completion of the module, the student system and the software executed on it. In particular, the on the hardware-centric abstraction layers from the asso the impact that these low abstraction levels have on an	to complete processors. Its are able to judge the interdepend ney shall understand the consequence embly language down to gates. This	dencies between tes that the exect way, they will be	a physical comp ution of software e enabled to evalu
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 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				
	Yes 10 % Excercises			
	90 minutes, contents of course and labs			
scale Assignment for the	General Engineering Science (German program, 7 semes	tor), Specialization Computer Science	o Compulsory	
Following Curricula	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 semes Compulsory General Engineering Science (German program, 7 semes Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes and Production: Compulsory General Engineering Science (German program, 7 semes and Production: Compulsory General Engineering Science (German program, 7 semes and Production: Compulsory	ster): Specialisation Naval Architectu ster): Specialisation Electrical Engine ster): Specialisation Biomedical Engin ster): Specialisation Energy and Envir ster): Specialisation Process Engineer semester): Specialisation Mechanica emester): Specialisation Mechanical mester): Specialisation Mechanical semester): Specialisation Mechanical ster): Specialisation Mechanical Engi	re: Compulsory ering: Compulsory eering: Compulsory eering: Compulsory al Engineering, I al Engineering, Foc cal Engineering, Foc cal Engineering, Focus Fh ineering, Focus Fh Engineering, Focus F	y y y ring: Compulsory Focus Mechatror focus Biomechar cus Aircraft Syste Focus Materials heoretical Mechar Product Developm us Energy Syste
	Compulsory General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical	Engineering, roc	us Energy Syste

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 Engineering		
Тур	cture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
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/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title Fundamentals of Fluid Mechanics (I	.0091)	Typ Lecture	Hrs/wk 2	CP 4
Fluid Mechanics for Process Engine	ering (L0092)	Recitation Section (large)	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous Knowledge	 Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial different Integration 	tial equations		
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence Knowledge				
Skills	 The students are able to describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering 			
Personal Competence				
	 The students are capable to gather information from subject related, professional publications and relate that information to the conterest of the lecture and able to work together on subject related tasks in small groups. They are able to present their results effectively in Englis (e.g. during small group exercises) are able to work out solutions for exercises by themselves, to discuss the solutions orally and to present the results. The students are able to search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. 			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Course achievement	Compulsory Bonus Form Yes 5 % Midterm	Description		
Examination				
Examination Examination duration and scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Process Engineer	ing: Compulsory	
-	General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Quali General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Science (English program, 7 Science) (English program) (English progr	semester): Specialisation Bioprocess Engin semester): Specialisation Energy and Envir semester): Specialisation Green Technolog ilsory ification: Compulsory semester): Specialisation Bioprocess Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri	eering: Compulso omental Enginee ies: Compulsory eering: Compulso omental Engineer	y

Course L0091: Fundamentals	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. 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	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.
	 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. 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 follo	wing learning results		
Professional Competence				
Knowledge	At the end of this module the students can:			
	- explain the methods of biological and biochemical research t	o determine the properties of biom	olecules	
	- name the basic components of a living organism			
	- explain the principles of metabolism			
	- describe the structure of living cells			
	-			
Skills				
Personal Competence				
	The students are able,			
	- to gather knowledge in groups of about 10 students			
	- to introduce their own knowledge and to argue their view in	discussions in teams		
	- to divide a complex task into subtasks, solve these and to pr	esent the combined results		
Autonomy	The students are able to present the results of their subtasks i	n a written report		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
	6			
Course achievement	None			
Examination	Written exam			
	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester):	Specialisation Bioprocess Engineer	ing: Compulso	ry
-	Bioprocess Engineering: Core Qualification: Compulsory			-
J	General Engineering Science (English program, 7 semester): S	pecialisation Bioprocess Engineeri	ng: Compulsor	v
	Orientierungsstudium: Core Qualification: Elective Compulsory		5	-

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

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. Barbara Klippel
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
Literature	 extremophiles 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/

	.0140) .0142)	Typ Lecture Recitation Section (small) Recitation Section (large)	Hrs/wk 2 1 1	CP 2 2 2
hase Equilibria Thermodynamics () hase Equilibria Thermodynamics () hase Equilibria Thermodynamics () Module Responsible Admission Requirements Recommended Previous	.0140) .0142) Prof. Irina Smirnova None	Lecture Recitation Section (small) Recitation Section (large)	2	2 2
hase Equilibria Thermodynamics (I hase Equilibria Thermodynamics (I Module Responsible Admission Requirements Recommended Previous	.0140) .0142) Prof. Irina Smirnova None	Recitation Section (small) Recitation Section (large)	1	2
hase Equilibria Thermodynamics (I Module Responsible Admission Requirements Recommended Previous	.0142) Prof. Irina Smirnova None	Recitation Section (large)		
Module Responsible Admission Requirements Recommended Previous	Prof. Irina Smirnova None		1	
Admission Requirements Recommended Previous	None	odvnamics I and II		2
Recommended Previous		odvnamics I and II		
	Mathematics, Physical Chemistry, Therm	odvnamics I and II		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge Skills	 equilibria. They learn how state variables are these properties. Moreover, the students learn how different phases (vapor, liquid, sol For different phase equilibria, see knowledge for plotting and interprese knowledge for plotting and interprese state and know how to simplify the The students know models which are able to solve the resulting mat For specific applications, they are model parameters in literature sou Beside pure compound properties The students know how to visualiz 	idents are able to identify the correct equation for ese equations meaningfully. can be used to determine the properties of the syst chematical relations. able to self-reliantly find necessary physico-chemica	n concepts to qu and which pher atals of reaction e cesses are shown the determination tem in the equili al properties of c s of mixtures. interpret the occ	uantitatively desc nomena may occu equilibria are taug n and the necess on of the equilibr brium state and t ompounds as wel urring phenomen
Personal Competence Social Competence Autonomy	other students The students are able to find nece 	groups, to solve the corresponding problems and to ssary information self-reliantly in literature sources a ts are able to check their learning progress conti	and to judge their	quality.
	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
Course achievement				
Examination	Written exam			
	120 minutes; theoretical questions and c	alculations		
scale				
Assignment for the Following Curricula	 General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory 			

rse 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		
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		
Workload in Hours	ndependent Study Time 46, Study Time in Lecture 14	
Lecturer	of. 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				
		Turn	Line /usis	CP
Title Bioprocess Engineering - Fundame	otals (10841)	Typ Lecture	Hrs/wk	СР 3
Bioprocess Engineering- Fundamen		Recitation Section (large)	2	1
Bioprocess Engineering - Fundame		Practical Course	2	2
Module Responsible	Prof. Andreas Liese			
Recommended Previous		"fundamentals for process engineering"		
Knowledge	none, module organic chemistry , module	randamentals for process engineering		
	After taking part successfully, students have	e reached the following learning results		
Professional Competence	Arter taking part successivity, stadents have			
	enzymes and microorganisms, as well as rheology can be named and mass transp fundamental bioprocess management, steri	cepts of bioprocess engineering. They are able to differentiate different types of inhibition. ort processes in bioreactors can be explained lization technology and downstream processing	The parameters of . The students are	f stoichiometry a
Skills	After successful completion of this module, describe different kinetic approaches 	students should be able to for growth and substrate-uptake and to calcula	te the correspondir	ng parameters
Autonomy Workload in Hours	fermentation process analyze bioprocesses on basis of stoi distinguish between scale-up criteria to compare them as well as to apply propose solutions to complicated biol to explore new knowledge resources identify scientific problems with conc to document and discuss their proced After completion of this module participants take position to their own opinions and incre After completion of this module participants workflow and to present their results in a p Independent Study Time 96, Study Time in I		quations erobic, aerobic as v sponding models in small teams to e and scientific envir	vell as microaerob nhance the ability onments.
Credit points				
Course achievement Compulsory Bonus Form Description				
	Yes 5 % Subject theoretica			
Page and Inc. 14	practical work			
	practical work Written exam			
Examination duration and scale	practical work Written exam 90 min			
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr	ram, 7 semester): Specialisation Process Engine		
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng		ıry
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification:	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory	ineering: Compulso	
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi	ineering: Compulso	
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra General Engineering Science (English progra	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee	ineering: Compulso neering: Compulso ring: Compulsory	
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu	ineering: Compulso neering: Compulso ring: Compulsory	
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory	ineering: Compulso neering: Compulso ring: Compulsory Isory	
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Co	ineering: Compulso neering: Compulso ring: Compulsory Isory mpulsory	
Examination duration and scale	practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi	ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Co agement and Business Administration: Elective Co	ineering: Compulso neering: Compulso ring: Compulsory Isory mpulsory	

Course L0841: Bioprocess En	gineering - Fundamentals		
Тур	Lecture		
Hrs/wk	2		
CP	}		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	rof. 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 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

Courses				
Title		Тур	Hrs/wk	СР
Heat and Mass Transfer (L0101) Heat and Mass Transfer (L0102)		Lecture Recitation Section (small)	2 1	2 2
Heat and Mass Transfer (L1868)		Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements				
Recommended Previous	Basic knowledge: Technical Thermodynamics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	 The students are capable of explaining qualitative and 	determining quantitative heat t	ransfer in proce	dural apparatus (e
	 The students are capable of explaining qualitative and heat exchanger, chemical reactors). 	determining quantitative near t		
	 They are capable of distinguish and characterize differ 	ent kinds of heat transfer mech	anisms namely h	eat conduction, h
	transfer and thermal radiation.		5	
	The students have the ability to explain the physica	al basis for mass transfer in o	letail and to de	scribe mass tran
	qualitative and quantitative by using suitable mass tran	nsfer theories.		
	 They are able to depict the analogy between heat- and 	mass transfer and to describe of	complex linked p	rocesses in detail.
Skills				
	The students are able to set reasonable system bound		blem by using th	ne gained knowled
	and to balance the corresponding energy and mass flow			
	 They are capable to solve specific heat transfer proble 	ems (e.g. heated chemical reac	tors, temperatur	e alteration in flu
	and to calculate the corresponding heat flows.			
	Using dimensionless quantities, the students can execu-			
	They are able to distinguish between diffusion, convec			n use this knowled
	for the description and design of apparatus (e.g. extrac			
	 In this context, the students are capable to choose and application considering their advantages and disadvantages. 		eat and mass exe	changer for a spec
	application considering their advantages and disadvant		ocodural apparat	
	 In addition, they can calculate both, steady-state and n The students are capable to connect their knowled 			
	particular the courses thermodynamics, fluid mechan	-	-	
	problems.	ines and chemical process eng	incernig, to solv	
Personal Competence				
Social Competence				
···· ,·· ·	 The students are capable to work on subject-specific of 	challenges in teams and to pres	ent the results o	orally in a reasona
	manner to tutors and other students.			
Autonomy				
Autonomy	 The students are able to find and evaluate necessary in 			
	 They are able to prove their level of knowledge during 	ing the course with accompany	ying procedure	continuously (click
	system, exam-like assignments) and on this basis they	can control their learning proce	sses.	
Marcalda and the	Independent Church Time 124, Church Time 1, 1, 1, 5, 5, 5,			
	Independent Study Time 124, Study Time in Lecture 56			
Credit points Course achievement				
	Written exam			
	120 minutes; theoretical questions and calculations			
scale				
	General Engineering Science (German program, 7 semester):	Specialisation Process Engineer	ina: Compulsory	
Following Curricula				
3 • • • • • •	General Engineering Science (German program, 7 semester):		÷ .	-
	General Engineering Science (German program, 7 semester):			ring: Compulsory
	Bioprocess Engineering: Core Qualification: Compulsory		-	
	Energy and Environmental Engineering: Core Qualification: Co	ompulsory		
	General Engineering Science (English program, 7 semester): S	Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 semester): S	Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 semester): S	Specialisation Process Engineeri	ng: Compulsory	
	Green Technologies: Energy, Water, Climate: Core Qualification	on: Compulsory		
	Technomathematics: Specialisation III. Engineering Science: E	lective Compulsory		
	Process Engineering: Core Qualification: Compulsory			

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 Mas	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	

Course L1868: Heat and Mas	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	

18) 19)	Typ Lecture	Hrs/wk	СР
	Lecture		
19)		2	2
	Recitation Section (small)	2	2
41)	Recitation Section (large)	1	1
Part laine Casimena	Practical Course	I	1
Prof. Irina Smirnova			
Recommended requirements: Thermodynamics III			
After taking part successfully, students have reached th	ne following learning results		
adsorptionThe students develop an understanding for the energy demand of a process, the possibilities of a statement of the s	course of concentration during a sepa energy saving, and the selection of sep	aration process, t paration systems	he estimation of t
 close the associated energy and material balance. The students can use different graphical meth theoretical stages required They can select and design a basic type of the disadvantages of the process The students are capable to obtain independent tables) They can calculate continuous and discontinuous The students are able to prove their theoretical k The students are able to discuss the theoretical colloquium. 	es lods for the designing of a separation ermal separation process for a given tly the needed material properties from s processes knowledge in the experimental lab work background and the content of the ex	n process and do case based on m appropriate so k. kperimental work and use it togeth	efine the amount the advantages a urces (diagrams a with the teachers
 The students can work technical assignments in small groups and present the combined results in the tutorial The students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and practical lab work in small groups and practical lab work in small groups are students are able to carry out practical lab work in small groups and practical lab work in small groups and practical lab work in small groups and practical lab work in small groups are students are students are students. 			
 them. They are able to discuss their results and to document them scientifically in a report. The students are capable to obtain the needed information from suitable sources by themselves and assess their quality The students can proof the state of their knowledge with exam resembling assignments and in this way control th learning process 			
Independent Study Time 96, Study Time in Lecture 84			
6			
None			
Written exam			
120 minutes; theoretical questions and calculations			
General Engineering Science (German program, 7 seme	ester): Specialisation Process Engineer	ing: Compulsory	
General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme Bioprocess Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualificat General Engineering Science (English program, 7 seme	ester): Specialisation Green Technologi semester): Specialisation Green Tech ester): Specialisation Energy and Enviro / ion: Elective Compulsory ster): Specialisation Bioprocess Engine ster): Specialisation Energy and Enviro	ies, Focus Renew Inologies, Focus omental Engineer eering: Compulsor omental Engineeri	able Energy: Elect Renewable Energ ring: Compulsory Y
	 The students can distinguish and describe diffiadsorption The students develop an understanding for the energy demand of a process, the possibilities of They have good knowledge of designing method Using the gained knowledge the students can secose the associated energy and material balance. The students can use different graphical meth theoretical stages required They can select and design a basic type of the disadvantages of the process The students are capable to obtain independent tables) The students are capable to obtain independent tables) The students are able to discuss the theoretical key in the students are able to discuss the theoretical colloquium. The students are capable of linking their gained knowle technical problems. Other lectures such as thermodyna The students are able to carry out practical lab them. They are able to discuss their results and limes. The students are capable to obtain the needed in the students are capable to obtain the needed in the students are capable to obtain the needed in the students are capable to obtain the needed in the students can proof the state of their knowlearning process Independent Study Time 96, Study Time in Lecture 84 6 None Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program, 7 seme General Engineering Science (German program, 7	 Recommended requirements: Thermodynamics III After taking part successfully, students have reached the following learning results The students can distinguish and describe different types of separation processes adsorption The students develop an understanding for the course of concentration during a separenergy demand of a process, the possibilities of energy saving, and the selection of separation processes and devices They have good knowledge the students can select a reasonable system boundary for close the associated energy and material balances The students can use different graphical methods for the designing of a separation theoretical stages required They can select and design a basic type of thermal separation process for a given disadvantages of the process The students are capable to obtain independently the needed material properties fror tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the experimental lab wor tables of the students are capable of linking their gained knowledge with the content of other lectures colloquium. The students are able to factures such as thermodynamics, fluid mechanics and chemical er them. They are able to discuss their results and to document them scientifically in a regulater and process. The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain t	Recommended requirements: Thermodynamics III After taking part successfully, students have reached the following learning results The students can distinguish and describe different types of separation processes such as distillat adsorption The students develop an understanding for the course of concentration during a separation process, energy demand of a process, the possibilities of energy saving, and the selection of separation systems They have good knowledge of designing methods for separation processes and devices Using the gained knowledge the students can select a reasonable system boundary for a given separat close the associated energy and material balances The students can use different graphical methods for the designing of a separation process and d theoretical stages required They can select and design a basic type of thermal separation process for a given case based on disadvantages of the process The students are capable to obtain independentity the needed material properties from appropriate so tables) The students are capable to obtain independentity the needed material properties from appropriate so tables) The students are able to prove their theoretical background and the content of the experimental work colloquium. The students are able to giscuss the theoretical background and the content of the reperimental work colloquium. The students can work technical assignments in small groups and present the combined results in the to the students can proof the state of their knowledge with texam resembling assignments and in th learning process The students can proof the state of their knowledge with exam resembling assignments and in th learning process The students are capable to obtain the needed information from suitable sources by themselves and as the students are able to acary out practical lab work in small groups and organize a functional divisi them. They are able to acary out practical lab work in small groups and organize a functional in th learning process The students can proof t

Process Engineering: Core Qualification: Compulsory

L

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

ourse L0119: Thermal Sepa	ration Processes		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP			
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 processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students. 		
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to 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 		

urse L0141: Thermal Sepa	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter 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 198 Ullmann"s Enzyklopädie der Technischen Chemie

L1159: Separation Pr	Practical Course
Hrs/wk	1
CP	
	Independent Study Time 16, Study Time in Lecture 14
	Prof. Irina Smirnova
Language	
Cycle Content	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquiur takes place in which the students explain and discuss the theoretical background and its translation into practice with staff an fellow students.
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. The 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 separatic 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

Module M0892: Chem	ical Reaction Engineering				
Courses					
Title		Тур		Hrs/wk	СР
Chemical Reaction Engineering (Fu	ndamentals) (I 0204)	Lect		2	2
Chemical Reaction Engineering (Fu			itation Section (large)	2	2
Experimental Course Chemical Eng			tical Course	2	2
Module Responsible	Prof. Raimund Horn				
Admission Requirements	None				
Recommended Previous	Contents of the previous modules mathema	tics I-III, physical chemi	stry, technical thermody	/namics I+II as w	ell as computationa
Knowledge	methods for engineers.				
Educational Objectives	After taking part successfully, students have	reached the following le	arning results		
Professional Competence					
Knowledge	The students are able to explain basic conce	epts of chemical reaction	engineering. They are	able to point out	differences betweer
	thermodynamical and kinetical processes. T	The students have a str	ong ability to outline pa	arts of isotherma	and non-isotherma
	ideal reactors and to describe their propertie	s.			
Skills	After successful completion of the module, st	tudents are able to:			
			l non issthormal ideal re		
	- apply different computational methods to d	imension isothermai and	i non-isothermai ideal re	actors,	
	- determine and compute stable operation po	pints for these reactors ,			
	- conduct experiments on a lab-scale pilot pla	ants and document these	e according to scientific	guidelines.	
Personal Competence					
•	After successful completition of the lab-cour	se the students have a	strong ability to organiz	e themselfes in s	mall groups to solv
,	issues in chemical reaction engineering. Th				
	their teachers.		,		
Autonomv	The students are able to obtain further	information and assess	their relevance auto	nomously. Studer	nts can apply thei
	knowldege discretely to plan, prepare and co				
Workload in Hours	Independent Study Time 96, Study Time in Lu				
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 Science (German progra	am, 7 semester): Special	isation Process Engineer	ring: Compulsory	
Following Curricula	General Engineering Science (German progra	am, 7 semester): Special	isation Bioprocess Engin	eering: Compulso	ory
	Bioprocess Engineering: Core Qualification: C	Compulsory			
	General Engineering Science (English progra	m, 7 semester): Speciali	sation Bioprocess Engine	eering: Compulso	гy
	General Engineering Science (English progra	m, 7 semester): Speciali	sation Process Engineeri	ng: Compulsory	
	Green Technologies: Energy, Water, Climate:	Specialisation Bioresour	ce Technology: Elective	Compulsory	
	Process Engineering: Core Qualification: Com	pulsory			

ourse L0204: Chemical Reaction Engineering (Fundamentals)		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn	
Language	DE	
Cycle	WiSe	
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions?, 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, 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 reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a 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) 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 ex
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

Course L0244: Chemical Reaction Engineering (Fundamentals)		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup	
Language	DE	
Cycle	WiSe	
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 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, interversible 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 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 reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of a membrane reactor, wole balance of a con
	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

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

Module M1275: Enviro	onmental Tech	nology			
Courses					
Title			Тур	Hrs/wk	CP
Practical Exercise Environmental Te	5,		Practical Course Lecture	1 2	1 2
Environmental Technologie (L0326	1		Lecture	Z	Z
Module Responsible		litt			
Admission Requirements					
Recommended Previous	Fundamentals of inor	ganic/organic chemistry	and biology		
Knowledge	A.C	<u></u>			
	After taking part succ	cessfully, students have r	reached the following learning results		
Professional Competence					
Knowledge	the behaviour of che		ts obtain profound knowledge of environn nt. Students can give an overview of scie		
Skills	Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinons in front of and against the group.				
Personal Competence					
Social Competence	The students are able	e to discuss the various t	echnical and scientific tasks, both subject	-specific and multidisci	plinary. They are at
	to develop different a	approaches to the task as	s a group as well as to discuss their theore	etical or practical imple	mentation.
Autonomy	Students can indeper	ndently exploit sources a	bout of the subject, acquire the particular	knowledge and tranfer	it to new problems
Workload in Hours	Independent Study Ti	ime 48, Study Time in Le	cture 42		
Credit points	3				
Course achievement	Compulsory Bonus	Form	Description		
	Yes None	Subject theoretical	and		
		practical work			
Examination	Written exam				
Examination duration and	1 hour				
scale					
Assignment for the	General Engineering	Science (German progra	m, 7 semester): Specialisation Process En	gineering: Elective Com	npulsory
Following Curricula			m, 7 semester): Specialisation Bioprocess		
			m, 7 semester): Specialisation Energy and	l Enviromental Enginee	ring: Compulsory
		ng: Core Qualification: El			
	5,7	5 5	Qualification: Compulsory		
			n, 7 semester): Specialisation Bioprocess		
			n, 7 semester): Specialisation Energy and	-	
			n, 7 semester): Specialisation Process Eng	ineering: Elective Com	puisory
	Process Engineering:	Core Qualification: Elect	ive compulsory		

Course L1387: Practical Exercise 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, Dr. Isabel Höfer	
Language	DE	
Cycle	SoSe	
Content	The practical course Environmental Engineering currently consists of 6 experiments, which deal with the different focal points of environmental engineering in the areas of air, water, soil, environment, biomass and noise. The following experiments are carried out for this purpose: Determination of the calorific value of biomass, soil purification, waste water treatment, noise emissions, plastic waste, biowaste. Translated with www.DeepL.com/Translator (free version) 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		
Literature		

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, Dr. Isabel Höfer
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
Bioprocess Engineering - Advanceo Bioprocess Engineering - Advanceo		Lecture Recitation Section (small)	2	4 2
		Reclation Section (Smail)	2	2
Module Responsible				
Admission Requirements Recommended Previous	None Content of module "Biochemical Engineering I	18		
Knowledge	content of module biochemical Engineering i			
	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
-	After successful completion of this module, stu	idents should be able to		
5				
	 describe and explain different kinetic approximation 	pproaches for growth and substrate-uptake		
	 identification of scientific problems with 	a concrete inductrial use (cultivation of microa	conicme and ma	mmalian colle)
	 Identification of scientific problems with 	n concrete industrial use (cultivation of microor	ganisms and ma	mmalian celis)
	 describe and explain important down 	streaming steps for proteins and their applic	ation as well as	basic immobilizat
	methods			
Skills	After successful completion of this module, stu	idents should be able to		
	to identify scientific questions or pass	ible practical problems for concrete indus	trial application	c (og cultivation
	microorganisms and animal cells) and to form			s (eg cultivation
	- To assess the application of scale-up criteria	for different types of bioreactors and processe	es and to apply th	nese criteria to giv
	problems (anaerobic , aerobic or microaerobic	ally)		
	- to formulate questions for the analysis and o	ptimization of real biotechnological production	processes appro	priate solutions ,
		ration, the regeneration of reduction equivalen	nts , and the gro	wth inhibition of t
	behavior of microorganisms and to the total fe	rmentation process qualitatively		
		nd solve them to determine the kinetic parar	neters of differer	nt approaches and
	calculate immobilization and activity yields ,			
	 to select process control strategies (batch , f 	ed-batch , continuity) appropriately and to cal	culate basic type	es and evaluate the
Demonstration of the second				
Personal Competence	After completion of this module participants s	hould be able to debate technical questions in	small toams to d	nhanco tho ability
Social competence	take position to their own opinions and increas		Sinai teans to e	interice the ability
	take position to their own opinions and increas			
Autonomy	After completion of this module participants a	re able to aquire new sources of knowledge ar	id apply their kno	wledge to previou
	unknown issues and to present these.			
Weedle ed by Using	la den en deut Chudu Time 124. Chudu Time in L	turn 50		
Workload in Hours		ecture ob		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale				
Assignment for the	General Engineering Science (German prograr	n 7 semester): Specialisation Rioprocess Engin	eering: Compuls	ory
-	Bioprocess Engineering: Core Qualification: Co		.compuls	<i>j</i>
. showing curriculu		 , 7 semester): Specialisation Bioprocess Engine 	eering: Compulso	ry
		Specialisation Bioresource Technology: Elective		-
	Technomathematics: Specialisation III. Engine		. ,	

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
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 En	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
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	Ту	/p	Hrs/wk	СР
Environmental Assessment (L0860)		cture	2	2
Environmental Assessment (L1054)) Rei	citation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	learning results		
Professional Competence				
Knowledge	With the completion of this module the students acquire in-dep environmental problems which might occur from production proces about the methodological diversity and are competent in dealing wi impacts. Besides the students are able to estimate the complexity difficulties with their measurement.	sses, projects or construction ith different methods and inst	measures. The truments to asse	y have knowled ess environment
Skills	The students are able to select a suitable method for the respective can develop suitable solutions for managing and mitigating environ out Life Cycle Impact Assessments independently and can apply t After finishing the course the students have the competence t environmental impacts.	nmental problems in a busine the software programs Open	ss context. They LCA and the da	are able to car tabase Ecolnver
Personal Competence				
Social Competence	The students are able to discuss the various technical and scientific to develop jointly different solutions and to discuss their theoreti topics, the students receive insights into the multi-layered issues of Their sensitivity and consciousness towards these subjects are rai social responsibilities in their role as engineers.	ical or practical implementat f the environment protection	tion. Due to the and the concept	e selected lecture selected lecture selected lecture selected lecture selected lecture selected sele
Autonomy	The students learn to research, process and present a scientific to scientific work. They can solve an environmental problem in a busing			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
	General Engineering Science (German program, 7 semester); Specia	alisation Process Engineering.	Elective Compu	lsorv
j	General Engineering Science (German program, 7 semester): Specia General Engineering Science (German program, 7 semester): Specia	5		,
J	General Engineering Science (German program, 7 semester): Specia			
	Bioprocess Engineering: Core Qualification: Elective Compulsory		2	
	Energy and Environmental Engineering: Core Qualification: Compuls	sory		
	General Engineering Science (English program, 7 semester): Special	-	g: Elective Com	pulsory
	General Engineering Science (English program, 7 semester): Special			
	General Engineering Science (English program, 7 semester): Special Process Engineering: Core Qualification: Elective Compulsory	lisation Energy and Enviromen	ntal Engineering	: 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	WiSe/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	Il 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	WiSe
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

Courses						
Гitle				Гур	Hrs/wk	СР
Process and Plant Engineering I (L0095)				Lecture	2	2
Process and Plant Engineering I (LO	096)		I	Recitation Section (large)	1	2
Process and Plant Engineering I (L1	214)		I	Recitation Section (small)	1	2
Module Responsible	Prof. Mirko Skiborows	ki				
Admission Requirements	None					
Recommended Previous	unit operation of ther	mal an dmechanical sep	aration processes			
Knowledge	chemical reactor eing	ineering				
Educational Objectives	After taking part succ	essfully, students have i	reached the following	g learning results		
Professional Competence						
Knowledge	students can:					
	classify and formulate	e blobal balance equatio	ns of chemical proce	sses		
	-					
	specify linear compor	nent equations of comple	ex chemical processe	2S		
	explain linear regress	ion and data reconcilliat	ion problems			
	explain pfd-diagrams					
Skills	students are capable of					
	- formulation of mass	and energy balance equ	ations and estimatio	on of product streams		
	- estimation of compo	onent streams of chemic	al plants using linear	component balance model	s	
	- solution of data reco	oncilliation tasks				
	- conduction of proce	ss synthesis				
	- economic evaluatior	n of processes and the e	stimation of producti	on costs		
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Ti	me 124, Study Time in L	ecture 56			
Credit points	6					
Course achievement	Compulsory Bonus Yes 10 %	Form	Description			
	Yes 10 %	Subject theoretical practical work	and			
Examination	Written exam	practical work				
Examination duration and		es and books				
scale	120 Mill. lectures not					
Assignment for the	General Engineering	Science (German progra	m. 7 semester): Spe	cialisation Process Engineer	ina: Compulsory	
Following Curricula				cialisation Bioprocess Engin		ory
5		ng: Core Qualification: Co		, ,	5 1	,
		-		ialisation Bioprocess Engine	ering: Compulsor	ry
	General Engineering	Science (English prog	ram, 7 semester):	Specialisation Energy and	Enviromental E	ingineering: Electi
	Compulsory		,			
		Science (English progran	n, 7 semester): Spec	ialisation Process Engineeri	ng: Compulsory	
				ource Technology: Elective		
	Process Engineering:			5,		

Course L0095: Process and P	lant 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

1	Date reconciliation and date validation
	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

Course L0096: Process and P	ourse L0096: Process and Plant Engineering I		
Тур	Recitation Section (large)		
Hrs/wk	1		
CP	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
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		

Courses						
Title			Тур		Hrs/wk	СР
Particle Technology I (L0434)			Lecture		2	3
Particle Technology I (L0435)			Recitation Sect		1	1
Particle Technology I (L0440)			Practical Cours	e	2	2
Module Responsible		h				
Admission Requirements	None					
Recommended Previous	keine					
Knowledge						
Educational Objectives	After taking part suc	ccessfully, students have	reached the following learning res	ults		
Professional Competence						
Knowledge	After successful con	mpletion of the module st	udents are able to			
	 name and ex 	plain processes and unit	-operations of solids process engin	eering		
			itions and to discuss their bulk pro	-		
	endidetenize	paraleles, paralele alsense				
Skills	Students are able to	0				
	 choose and d 	lesign apparatuses and p	rocesses for solids processing acco	rding to the des	ired solids prop	erties of the prod
			vior in solids processing steps			
	 document the 	eir work scientifically.				
Personal Competence						
	The students are a	able to discuss scientific	topics orally with other students	or scientific per	sonal and to d	develop solutions
	technical-scientific i					
Autonomy			ions regarding solid particles indep	pendently.		
Workload in Hours		Time 110, Study Time in	Lecture 70			
Credit points	6 Compulsory Bonus	Form	Description			
Course achievement	Yes None	Written elaboration	sechs Berichte (pro Versuch	ein Bericht) à 5-	-10 Seiten	
Examination	Written exam			,		
Examination duration and	-					
scale						
Assignment for the	General Engineering	g Science (German progra	am, 7 semester): Specialisation Pro	cess Engineering	a: Compulsory	
Following Curricula	5		am, 7 semester): Specialisation Bio			orv
· · · · · · · · · · · · · · · · · · ·			am, 7 semester): Specialisation G			-
	Engineering: Electiv		. , ,			
			am. 7 semester): Specialisation En	ergy and Environ	nental Enginee	rina: Compulsorv
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsor Bioprocess Engineering: Core Qualification: Compulsory					3 j
		-	Qualification: Elective Compulsory	/		
					ing: Compulso	ry
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory					
		a Science (English progra	m. 7 semester): Specialisation Ene	rgy and Envirom	ental Engineer	ing: Compulsory
	General Engineering				-	ing: Compulsory
	General Engineering General Engineering	g Science (English progra	m, 7 semester): Specialisation Ene m, 7 semester): Specialisation Proc Specialisation Water: Elective Cor	cess Engineering	-	ing: Compulsory

Course L0434: Particle Techn	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
	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

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

Course L0440: Particle 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.

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

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	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for	calculating electrical circuits. They know	v the Fourier ser	ies analysis of linear
	networks driven by periodic signals. They know the	e methods for transient analysis of linea	r networks in ti	me and in frequency
	domain, and they are able to explain the frequency	pehaviour and the synthesis of passive tw	o-terminal-circui	ts.
Skills	The students are able to calculate currents and ve			
	periodic signals. They are able to calculate transient		5	
	respective transient behaviour. They are able to a	nalyse and to synthesize the frequency	behaviour of p	assive two-terminal-
	circuits.			
Personal Competence				
Social Competence				
	group.			
Autonomy	The students are able to find out the required meth	ads for solving the given practice problem	ne Possibilitios a	ro givon to tost thoir
Autonomy	knowledge during the lectures continuously by n			
	educational objectives. They can link their gained kr			
	,			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
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 Mechanica	l Engineering,	Focus Mechatronics
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 se		ering: Compulsor	у
	Electrical Engineering: Core Qualification: Compulso			
	General Engineering Science (English program, 7 se			
	General Engineering Science (English program,	/ semester): Specialisation Mechanica	Engineering,	Focus Mechatronics
	Compulsory	en II. Methemetice C. Fraincarian C.	- Elective Com	Jeen
	Computational Science and Engineering: Specialisat			льогу
	Computational Science and Engineering: Specialisat	on Engineering Sciences: Elective Compu	isory	
	Mechatronics: Core Qualification: Compulsory	cionco: Electivo Compulson		
	Technomathematics: Specialisation III. Engineering S	cience. Elective Compulsory		

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, Dr. Fabian Lurz
Language	DE
Cycle	WiSe
Content	see interlocking course
Literature	siehe korrespondierende Lehrveranstaltung
	see interlocking course

TitleTypHrs/wkCPComputer Engineering (L0321)Lecture34	Courses				
Image: Comparison (0.022) Im			Typ	Hrs/wk	CP
Module Responsible (Port Links is all Additional Requirements None Recommendated Provides Biocentimed Provides Recommendated Provides Recommendated Provides Recommendated Provides Recommendated Provides Recommendated Provides Recommendated Compatibility Statistics None Recommendation	Computer Engineering (L0321)				
Admission Requirements Recommended Privates Non- Recommended Privates Extractional Objectives After taking pert successfully, students have reached the following learning results Professional Competence Knowledge Introduct data 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: Introductional sign: Class, Boolean adjetra, Boolean functions, hardware synthesis, combinational networks Equivalence of the synthesis, Sonthalt, and the synthesis, combinational networks Introductional sign: Class, Boolean adjetra, Boolean functions, hardware synthesis, combinational networks Equivalence of the synthesis, Sonthalt, and s	Computer Engineering (L0324)		Recitation Section (small)	1	2
Recommended Previous Buil: Increasing in decidical engineering Professional Competence Reconstructional Dijectives After taking parts taccessfully, students have reached the following teaming results Professional Comparing Reconstruction Increasing and the taking parts taccessfully, students have reached the following teaming results Professional Comparing Reconstruction Increasing and the taking comparing approximation of the functionality of comparing systems. It covers the layers from the assembly programming date to gates. The module includes the following teaming results Included: Included: Incl	Module Responsible	Prof. Heiko Falk			
Non-windpa Instrumental end of the foundation of the foundatio	Admission Requirements	None			
Educational Objective After taking parts accorduly, students have reached the following learning results Professional Computing Resolution 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 inputs: Introduction Combinational logic: Following Longenza Combinational logic: Following Longenza Combinational logic: Following Longenza Combinational logic: Following Longenza Extended Logic Endocuments Extended Logic Endocumen	Recommended Previous	Basic knowledge in electrical engineering			
Professional Competence Knowledge This montule deals with the foundations of the functionality of computing systems. It exvers the layers from the assembly programming down to gates. The module includes the following topics: Introduction Compate antimuted: Integer addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. Beace analyse, New Bigle scycle architecture, pipelining Research of compater systems. From the architecture programming models. Mits Subjectific and individual computers can be built beace Beace and the other antimetics. They are able to distinguish between and to explain the different abstraction layer than one base built beace on the distinguish between and to explain the different abstraction layer than models. The subtracts are able to judge the introdynetices between a physical componence Beace and the other accented on a In particular, they shall understand the companiences built beace on the impact that these law statuction layers from the assembly impaged adown to gates. The substate are able to judge the introdynet componence built beace on the assemble for agreed advise of the propose feasible options. Personal Compatero Social Compatero Suddents are able to solve similar problems alone or in a group and to prosent the results accordingly. Autonomy Students are able to acquire new knowledge from specific literature and to aphree assemble of participation and the other antipation approxim. J semisteris Specialisation Biopering Computery General Engineering Science (German program. 7 semisteris Specialisation Mechanical Engineering, Focus Mechanic Computery General Engineering Science (German program. 7 semisteris Speciali	Knowledge				
Nonvelocity This module deals with the foundations of the functionality of compating systems. It covers the layers from the assembly programming down to gates. The module includes the following topics: Initioaction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Segurate altitudes: Linteger addition, subtraction, mutiplication and division Basics of computer architecture: Programming models, MPS single-cycle architecture, pipelining Memore: Memory hierarchies, SMAD, MDA, caches The students paretexic computer systems. The students are able to oldstipudet between and to explain the different abstraction layers. Ann highly specific and individual computers can be built based Compation of computer systems. The students are able to oldstipudet between and to explain the different abstraction layers. The individual computers can be built based Parsonal Competence Social Competence Sudents are able to solve similar problems alone on in a group and to present the musils accordingly. Parsonal Competence Social Competence Sudents are able to solve similar problems alone on in a group and to present the musils accordingly. Parsonal Competence Social Competence Social Competence Social Competence Social Competence Social Competence Social Competence Social Competence Social Competence So	Educational Objectives	After taking part successfully, students have reached the	following learning results		
Personal Competence Social Competence Social Competence Social Competence Sequence in logics Fight Repr. submittee in the second multiplication and division Between the second division Between the second division of the second division of the second division of the second division Between the second division Between the second division of the second division of the second division Between the second division Between the second division of the second division of the second division Between the second division Second division of computer systems from the architects preservice i.e. they identify the internal hours and the oblig between and to second division of computer systems. The students are able to division between and to explain the different abstraction layer from division and the oblig between and the software executed on the making. The second division divisi	Professional Competence				
Combinational logic: Gates, Bookan algebra, Bookan functions, hardware synthesis, combinational networks Sequential logic: Floreport, authoretics, systematic hardware design T-chronological foundations Computer arthmetic: hereport authoretics, multiplication and dividion Basics of computer arthmetic: Floreport, Bookan, MPS single-cycle architecture, pipelining Memorites, Memory herarches, SAMA, DAAA, caches Heredocati. Vio from the perspective of the CPU, principles of passing data, point-to-point connections, busses Setils The students perceive computer systems from the architectry perspective, Le., they identify the internal antiture and the pipe composition of computer systems. They are able to didpinguish between and to explain the different abstraction lays today's computing systems. They are able to didpinguish between and to explain the different abstraction lays today's computing systems. The maskes and circuits up to complete processors. After successful completion of the models. The submethal are able to judge the interdependencies between a physical com system and the software executed on 1. In particular, they shull undenstand the consequences that the exalise to explore the impact that these low abstraction levels have on an entire system's performance and to propose feesible options. Personal Competence Social Competence Sudents are able to acquire new inoviedge from specific literature and to associate this inoviedge with other classes. Workfoad In Hears: Josephrometry Substrates of course and labs Social Course achievements Software property from in Lecture 36 Exercises Exercises Software property from 30 Signature and property. Specialization Manufers Control, Study Time 24, Study Time 14, Stu	Knowledge				
composition 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 belween and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the mobule, the students are able to judge the interdependencies between a physical com system and the software socureted on it. In particular, they shall understand the consequences that the execution of abitivation on the hardware-entric abstraction layers from the assembly language down to gates. This way, they will be enabled to eval the impact that less low abstraction levels have on an entire system's performance and to propose feasible options. <i>Autonomy</i> Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. Workload In Hows independent Study Time 224, Study Time in Lecture 56 Control 1990 Second 1990 Examination duration and 30 minutes, contents of course and lais Examination duration and 30 minutes, contents of course and lais Course achievenut Following Currier Following Currier Following Currier Following Currier General Engineering Science (German program, 7 semester): Specialisation Computer Science: Computsory General Engineering Science (German program, 7 semester): Specialisation Nava Architecure: compulsory General Engineering Science (German program, 7 semester): Specialisation Nava Architecure: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Matchat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matchat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matchat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matchat Com		 Combinational logic: Gates, Boolean algebra, Boole Sequential logic: Flip-flops, automata, systematic h Technological foundations Computer arithmetic: Integer addition, subtraction, Basics of computer architecture: Programming more Memories: Memory hierarchies, SRAM, DRAM, cach 	ardware design multiplication and division dels, MIPS single-cycle architecture, es	pipelining	
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 Course achievement Remothory Born Form Description Remothory Born Form Description Examination duration and So minutes, contents of course and labs Social Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation 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 Mechanical Engineering. Focus Mechanical Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanical Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanical Engineering: Compulsory General Engineering Science (German prog	Skills	composition of computer systems. The students can anal collection of few and simple components. They are able today's computing systems - from gates and circuits up to After successful completion of the module, the students system and the software executed on it. In particular, the on the hardware-centric abstraction layers from the asse	yze, how highly specific and individ to distinguish between and to exp o complete processors. are able to judge the interdepend ey shall understand the consequence mbly language down to gates. This	ual computers car lain the different i dencies between i ces that the execu way, they will be	h be built based of abstraction layers a physical compu- tion of software enabled to evalu
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 Hous Independent Study Time 124, Study Time in Lecture 56 Course achievement Computery Items Items Research 10 % Excercises Examination duration and Scale Solutions, contents of course and labs Examination duration and Scale General Engineering Science (German program, 7 semester): Specialisation Navquita Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Navquita Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Navquita Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanica					
Autonom 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 Course achieveneit Computery Benue Yerm Versition Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. Examination duration and 30 minutes, contents of course and labs scale 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 Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mendical Engineering; Compulsory General Engineering Science (German program, 7 semester): Specialisation Mendical Engineering, Focus Micrature Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrature Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrature Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrature Compulsory General Engineering Sc				a setting and a	
Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Course achievement Computery Teorus Porm Description Course achievement Computery Teorus Porm Description Examination Written exam Examination and 90 minutes, contents of course and labs scale Examination Gurricula General Engineering Science (German program, 7 semester): Specialisation Servers Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioercical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioercical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Envinomental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory <	Social Competence	Students are able to solve similar problems alone or in a g	group and to present the results acc	cordingly.	
Credit points 6 Course achievement Computary Banus Form Description Yes 10 % Excercises Examination Examination duration and 90 minutes, contents of course and labs scala Assignment for the 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 Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineerin	Autonomy	Students are able to acquire new knowledge from specific	literature and to associate this kno	wledge with othe	classes.
Credit points 6 Course achievement Computery Bonus Form Description Yes 10 % Excercises Examination Examination duration and 90 minutes, contents of course and labs scale Assignment for the 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 Bioredical 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 Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineerin					
Course achievement Computery Bernix Form Description Yes 10 % Extercises Examination Examination duration and scale 30 minutes, contents of course and labs 30 Assignment for the Following Curricula 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 Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bergy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Dercess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory					
Yes 10 % Excercises Examination Written exam Examination duration and social 30 minutes, contents of course and labs scale General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Following Curricula 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 Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mecharic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mecharic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mecharic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory			tion		
Examination duration and scale 90 minutes, contents of course and labs Assignment for the Following Curricula 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 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 Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alterat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester)	course achievement				
scale Assignment for the Following Currical 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 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 Mechanical Engineering, Focus Mechatro General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomeche Gompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst	Examination	Written exam			
Assignment for the Following Curricula 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 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: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering Science (German program, 7 semester): Specialisation Mechanical Eng	Examination duration and	90 minutes, contents of course and labs			
Following CurriculGeneral Engineering Science (German program, 7 semester): Specialisation Bloprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: compulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: compulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: CompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst CompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst CompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst CompulsoryGeneral Engineering Scienc	scale				
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 Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercate Specialisation Mechanical Engineering, Focus Alercate Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercate Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Com	Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Computer Science	e: 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 Mechanical Engineering, Focus Mechatr General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineer	Following Curricula	General Engineering Science (German program, 7 semest	er): Specialisation Bioprocess Engir	eering: Compulso	ry
General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercraft Sys Engineering Science: (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst 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 Science (German program, 7 semester): Specialisation Electrical Eng		General Engineering Science (German program, 7 semest	er): Specialisation Naval Architectu	re: Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomeche Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation		General Engineering Science (German program, 7 semest	er): Specialisation Electrical Engine	ering: Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomeche Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory		General Engineering Science (German program, 7 semest	er): Specialisation Biomedical Engir	eering: Compulso	ry
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Data Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Betectrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		General Engineering Science (German program, 7 semest	er): Specialisation Energy and Envir	omental Engineer	ing: Compulsory
Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory		General Engineering Science (German program, 7 semest	er): Specialisation Process Engineer	ring: Compulsory	
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systengineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systengineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: 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 Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic 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 Civil Engineering: Compulsory General Engineering Science (German program, 7 seme		Conoral Engineering Science (Corman program 7 c)		al Engineering, F	ocus Mechatron
Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Computery 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 General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory			emester): Specialisation Mechanic		
Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst 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 General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 se		al Engineering, F	ocus Biomechan
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst 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 General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory	mester): Specialisation Mechanica	Engineering, Foc	us Aircraft Syste
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy SystCompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy SystCompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Civil Engineering: CompulsoryComputer Science: Core Qualification: CompulsoryData Science: Core Qualification: Elective CompulsoryElectrical Engineering: Core Qualification: CompulsoryGeneral Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: CompulsoryGeneral Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: CompulsoryGeneral Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory	mester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechani	Engineering, Foc	us Aircraft Syste Focus Materials
General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst 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 General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 s Engineering Sciences: Compulsory General Engineering Science (German program, 7 semesi Engineering: Compulsory General Engineering Science (German program, 7 semesi	mester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechani ter): Specialisation Mechanical Engi	Engineering, Foc cal Engineering, neering, Focus Th	us Aircraft Syste Focus Materials eoretical Mechan
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 General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 s Engineering Sciences: Compulsory General Engineering Science (German program, 7 semesi Engineering: Compulsory General Engineering Science (German program, 7 semesi and Production: Compulsory General Engineering Science (German program, 7 semesi	emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechani ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Eng	Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P	us Aircraft Syste Focus Materials eoretical Mechan roduct Developm
Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 sen Engineering Sciences: Compulsory General Engineering Science (German program, 7 seness Engineering: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness Compulsory General Engineering Science (German program, 7 seness)	emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical	Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu	us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy System
General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory		Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 sen Engineering Sciences: Compulsory General Engineering Science (German program, 7 seness Engineering: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness Compulsory General Engineering Science (German program, 7 seness Compulsory General Engineering Science (German program, 7 seness	emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical nester): Specialisation Mechanical	Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu Engineering, Focu	us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy Syster
		Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser 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 Compulsory General Engineering Science (German program, 7 ser Computer Science: Core Qualification: Compulsory	emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical nester): Specialisation Mechanical	Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu Engineering, Focu	us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy Syste
		Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser 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 Compulsory General Engineering Science (German program, 7 ser Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 serest	emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical nester): Specialisation Mechanical er): Specialisation Civil Engineering	Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu Engineering, Focu : Compulsory	us Aircraft Syste Focus Materials eoretical Mechar roduct Developm us Energy Syste

	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
1	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
i	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
1	Mechatronics: Core Qualification: Compulsory
-	Technomathematics: Specialisation II. Informatics: Elective Compulsory

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/EN	
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	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/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Theoretical Electrical Engineering I Theoretical Electrical Engineering I	-	Lecture Recitation Section (small)	3 2	5 1
	Prof. Christian Schuster			
Admission Requirements				
Recommended Previous Knowledge	Basic principles of electrical engineering and ac	vanced mathematics		
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence Knowledge	Students can explain the fundamental formula: They can explicate the principal behavior of sources. They can describe the properties of fields. The students are aware of applications f these.	electrostatic, magnetostatic, and current complex electromagnetic fields by means	density fields with of superposition o	regard to respective f solutions for simp
Skills	Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independen electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell' Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields ar analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, an electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications			
Personal Competence Social Competence	Students are able to work together on subject i during exercise sessions).	elated tasks in small groups. They are abl	e 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 connec- lectures (e.g. Electrical Engineering I, Linear Alg	eans of activities that accompany the lect kam. Based on respective feedback, studer ections between their knowledge obtained	ure, such as short o its are expected to	ral quizzes during tl adjust their individu
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and scale	90-150 minutes			
Assignment for the Following Curricula	General Engineering Science (German program Electrical Engineering: Core Qualification: Comp Computational Science and Engineering: Specia	pulsory		

ourse L0180: Theoretical Ele	Lecture
Hrs/wk	
CP	
	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Christian Schuster
Language	DE
Cycle	
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	rse 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 (L07)	4)	Lecture	1	1
Materials in Electrical Engineering		Lecture	2	3
Materials in Electrical Engineering	Problem Solving Course) (L0687)	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 c explicate the relevance of mechanical, electrical, thermal, dielectric, magnetic and chemical properties of materials in view of th applications in electrical engineering.			
Skills	Students can identify appropriate descriptivand judge factors influential on the performation			oroximative solutio
Personal Competence Social Competence	Students can jointly solve subject related pro problem solving course.	oblems in groups. They can present their res	ults effectively within	the framework of
Autonomy	Students are capable to extract relevant info the lecture. They can reflect their acquirec typical exam questions. Students are able to	l level of expertise with the help of lecture	e accompanying mea	
Workload in Hours	Independent Study Time 110, Study Time in	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	am, 7 semester): Specialisation Electrical En	gineering: Compulsor	у
Following Curricula	Electrical Engineering: Core Qualification: Co	mpulsory		
	General Engineering Science (English progra	m, 7 semester): Specialisation Electrical Eng	ineering: Compulsory	r
	Computational Science and Engineering: Spe	ecialisation Engineering Sciences: Elective Co	ompulsory	
	Orientierungsstudium: Core Qualification: Ele	ati a Camada a		

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

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)

Module M0854: Mathe	ematics IV				
Courses					
Courses		-		<u></u>	
Title Differential Equations 2 (Partial Diff	forential Equations) (11042)	Typ Lecture	Hrs/wk 2	CP 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	Prof. Anusch Taraz				
Admission Requirements	None				
Recommended Previous	Mathematics 1 - III				
Knowledge					
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	 Students can name the basic concepts in Math 	omatics IV. They are able to explain then	o using appropria	ato oxamplos	
	 Students can hame the basic concepts in Mati Students can discuss logical connections betw 				
	the help of examples.	teen these concepts. They are capable	or muscrating th	ese connections with	
	 They know proof strategies and can reproduce 	them			
	· mey know proor strategies and can reproduce				
Skills					
SKIIS	 Students can model problems in Mathematics 	IV with the help of the concepts studie	ed in this course	. Moreover, they are	
	capable of solving them by applying establishe				
	 Students are able to discover and verify further 	5			
	 For a given problem, the students can devel 	op and execute a suitable approach, ar	nd are able to c	itically evaluate the	
	results.				
Personal Competence					
Social Competence	 Students are able to work together in teams. T 	hey are capable to use mathematics as a	a common langua	ade	
	 In doing so, they can communicate new conce 				
	design examples to check and deepen the unc		y p	,,	
Autonomy					
	 Students are capable of checking their underst 	standing of complex concepts on their or	wn. They can sp	ecify open questions	
	precisely and know where to get help in solvin				
	 Students have developed sufficient persistent 	ce to be able to work for longer periods	s in a goal-orien	ted manner on hard	
	problems.				
Workload in Hours	Independent Study Time 68, Study Time in Lecture 1	12			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	60 min (Complex Functions) + 60 min (Differential Ed	luations 2)			
scale					
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Electrical Enginee	ring: Compulsory	/	
Following Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering, I	ocus Mechatronics	
	Compulsory				
	General Engineering Science (German program, 7 se				
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechanica	
	Engineering: Elective Compulsory	· · · · · · · ·			
	Computer Science: Specialisation Computational Mat				
	Computer Science: Specialisation II. Mathematics and		ry		
	Electrical Engineering: Core Qualification: Compulsor				
	Engineering Science: Specialisation Electrical Engine		ing, Committee		
	General Engineering Science (English program, 7 sen				
	General Engineering Science (English program, 7 sen				
	General Engineering Science (English program, 5 Compulsory	semester, specialisation Mechanical	Engineering, 1	JULIA MECHALIONICS	
	Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan				
	Engineering: Compulsory	nestery, specialisation methallical Englin	comy, rocus III		
	General Engineering Science (English program, 7 sen	nester): Specialisation Naval Architecture	Compulsory		
	Computational Science and Engineering: Specialisation			lsorv	
	Mechanical Engineering: Specialisation Mechatronics				
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory				
	Mechanical Engineering: Specialisation Theoretical M				
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Compulsory				
ł					

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
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 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 Fund	tions				
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 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					
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 comple	exe numbers, integrals, differentials			
Knowledge					
	Basics of electrical engineering and mechar	nical engineering			
Educational Objectives	After taking part successfully, students have	e reached the following learning results			
Professional Competence					
Knowledge	Students can to draw and explain the basic	c principles of electric and magnetic fields.			
		the standard types of electric machines and present the corresponding equations a			
		ves they can explain the major parameters of	the energy emciency	y of the whole syst	
	from the power grid to the driven engine.				
Skills	Students arw able to calculate two-dimens	sional electric and magnetic fields in particul	ar ferromagnetic circ	uits with air gap.	
	this they apply the usual methods of the de	esign auf electric machines.			
	They can calulate the operational perform	ance of electric machines from their given s	haractoristic data an	d colocted quantit	
		nance of electric machines from their given c usual equivalent circuits and graphical method		ia selectea quantit	
	and characteristic curves. They apply the d	sual equivalent circuits and graphical method	15.		
Personal Competence					
Social Competence		to electric and magnatic fields for application	They are able to a	nalyca indonanda	
Autonomy	Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse independent the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantiti				
	and characteristic curves.	senines norm the characteristic data and the	sycan calculate theree	or selected quantit	
Workload in Hours	Independent Study Time 110, Study Time ir	n Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Subject theoretical and practical work				
Examination duration and	Design of four machines and actuators, revi	iew of design files			
scale					
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Energy and I	Enviromental Enginee	ering: Compulsory	
Following Curricula	General Engineering Science (German prog	gram, 7 semester): Specialisation Electrical En	gineering: Elective Co	ompulsory	
	General Engineering Science (German prog	ram, 7 semester): Specialisation Mechanical E	Engineering: Elective	Compulsory	
	General Engineering Science (German pre-	ogram, 7 semester): Specialisation Mechan	ical Engineering, Foo	cus Energy Syster	
	Compulsory				
	General Engineering Science (German p	program, 7 semester): Specialisation Mech	anical Engineering,	Focus Mechatron	
	Compulsory				
		gram, 7 semester): Specialisation Mechanical	Engineering, Focus Tl	heoretical Mechani	
	Engineering: Elective Compulsory				
	Digital Mechanical Engineering: Core Qualifi				
	Electrical Engineering: Core Qualification: E Energy and Environmental Engineering: Cor				
		ram, 7 semester): Specialisation Electrical Eng	nineering: Elective Co	mpulsory	
		ram, 7 semester): Specialisation Electrical Eng ram, 7 semester): Specialisation Energy and E			
			-		
	General Engineering Science (English progr	am. 7 semester): Specialisation Mechanical E			
		ram, 7 semester): Specialisation Mechanical E pecialisation Engineering Sciences: Elective Co		compulsory	
	Computational Science and Engineering: Sp	pecialisation Engineering Sciences: Elective Co		compulsory	
		pecialisation Engineering Sciences: Elective Co eering Science: Elective Compulsory		compulsory	
	Computational Science and Engineering: Sp Logistics and Mobility: Specialisation Engine	pecialisation Engineering Sciences: Elective Co eering Science: Elective Compulsory : Elective Compulsory		compuisory	

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	hines and Actuators
Тур	Recitation Section (large)
Hrs/wk	2
CP	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				
		True	Line (sule	CD.
Title	nas, and Electromagnetic Compatibility (L1669)	Typ Lecture	Hrs/wk 3	CP 4
=	nas, and Electromagnetic Compatibility (L1009)	Recitation Section (small)	2	2
	Prof. Christian Schuster		-	-
Admission Requirements	None			
Recommended Previous	Basic principles of physics and electrical engineering			
Knowledge	basic principles of physics and electrical engineering			
5	After taking part successfully, students have reached t	he following learning results		
Professional Competence	Arter taking part successiony, students have reached			
•	Students can evoluin the basis principles, relationshi	as and mothods for the design of wa	voquidos and an	toppos os well os
Knowledge	Students can explain the basic principles, relationshi	ps, and methods for the design of wa	veguides and an	tennas as well as
	Electromagnetic Compatibility. Specific topics are:			
	- Fundamental properties and phenomena of electrical	circuits		
	- Steady-state sinusoidal analysis of electrical circuits			
	- Fundamental properties and phenomena of electrom	agnetic fields and waves		
	- Steady-state sinusoidal description of electromagnet	c fields and waves		
	- Useful microwave network parameters			
	- Transmission lines and basic results from transmissio	n line theory		
	- Plane wave propagation, superposition, reflection and	l refraction		
	- General theory of waveguides			
	- Most important types of waveguides and their proper	ties		
	- Radiation and basic antenna parameters			
	- Most important types of antennas and their propertie	s		
	- Numerical techniques and CAD tools for waveguide a	nd antenna design		
	- Fundamentals of Electromagnetic Compatibility			
	- Coupling mechanisms and countermeasures			
	- Shielding, grounding, filtering			
	- Standards and regulations			
	- EMC measurement techniques			
Skills	Students know how to apply various methods and mo	dels for characterization and choice of	waveguides and	antennas. They a
	able to assess and qualify their basic electromagn			
	Electromagnetic Compatibility to the development of e		5	
Personal Competence				
Social Competence	Students are able to work together on subject related	I tasks in small groups. They are able	to present their	results effectively
	English (e.g. during small group exercises).			
Autonomy	Students are capable to gather information from su	bject related professional publication	s and relate tha	t information to t
	context of the lecture. They are able to make a conn			
	other lectures (e.g. theory of electromagnetic fields, f			
	problems and physical effects in English.	, and a mental of clocklear engineering ,	physics). They c	
Workload in Hours)		
Credit points		-		
Course achievement				
Examination				
Examination duration and	45 min			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	ester): Specialisation Electrical Enginee	ering: Elective Co	mpulsory
	Electrical Engineering: Core Qualification: Elective Con			
	Aircraft Systems Engineering: Specialisation Air Transp	ortation Systems: Elective Compulsory		
	Aircraft Systems Engineering: Specialisation Cabin Sys	tems: Elective Compulsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Electrical Engineer	ing: Elective Cor	npulsory
	Mechatronics: Specialisation System Design: Elective (

Тур	Lecture
Hrs/wk	
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
	Prof. Christian Schuster
Language	DE/EN
Cycle	
-	This course is intended as an introduction to the topics of wave propagation, guiding, sending, and receiving as well a
	Electromagnetic Compatibility (EMC). It will be useful for engineers that face the technical challenge of transmitting high frequence
	/ 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
	- 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
	- 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	o Waveguides, Antennas, and Electromagnetic Compatibility
Тур	Recitation Section (small)
Hrs/wk	2
CP	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	d Random Processes (L0443)	Recitation Section (large)	1	1
ntroduction to Communications ar	d Random Processes (L2354)	Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	 Mathematics 1-3 			
Knowledge	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 s	ystem. They can o	describe and anal
	the individual building blocks using knowled	dge of signal and system theory as well as the t	heory of stochasti	c processes. The
	aware of the essential resources and evalu	ation criteria of information transmission and a	e able to design	and evaluate a ba
	communications system.			
Skills	The students are able to design and evaluate a basic communications system. In particular, they can estimate the require			
	resources in terms of bandwidth and powe	r. They are able to assess essential evaluation p	arameters of a ba	asic communicatio
	system such as bandwidth efficiency or bit e	error rate and to decide for a suitable transmission	n method.	
Personal Competence				
Social Competence	The students can jointly solve specific prob	lems.		
Autonomy	The students are able to acquire relevan	nt information from appropriate literature sou	rces. They can c	ontrol their level
		ing tutorial problems, software tools, clicker syst	-	
		····g,,,,,		
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
Course achievement				
Examination				
Examination duration and	90 min			
scale				
	5 5 7 5	ram, 7 semester): Specialisation Electrical Engine	ering: Compulsor	у
Following Curricula		and Software Engineering: Elective Compulsory		
	Computer Science: Specialisation Computat			
	Data Science: Core Qualification: Elective Co			
	Electrical Engineering: Core Qualification: Co	ompulsory		
	General Engineering Science (English progra	am, 7 semester): Specialisation Electrical Engine	erina: Compulsorv	
	centeren Engineering berentee (English progr			
	Computational Science and Engineering: Co			

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)
	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	o 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	o 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

Module M1235: Electr	ical Power Systems I: Introduction	to Electrical Power System	S	
Courses				
Title		Тур	Hrs/wk	СР
-	tion to Electrical Power Systems (L1670)	Lecture	3	4
Electrical Power Systems I: Introduc	tion to Electrical Power Systems (L1671)	Recitation Section (small)	2	2
Module Responsible	Prof. Christian Becker			
Admission Requirements	None			
Recommended Previous	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	nal and modern electric power systems.	They can explain i	n detail and critically
	evaluate technologies of electric power generation, transmission, storage, and distribution as well as integration of equipment in			
	electric power systems.			
Skille	With completion of this module the students are able to apply the acquired skills in applications of the design, integratio development of electric power systems and to assess the results.			
38///3				
	development of cleatile power systems and to ass			
Personal Competence				
Social Competence	The students can participate in specialized and inte	erdisciplinary discussions, advance ideas	and represent thei	r own work results ir
	front of others.			
Autonomy	Students can independently tap knowledge of the	emphasis of the lectures.		
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Course achievement				
Examination				
Examination duration and				
scale	50 ISO minutes			
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Electrical Engin	eering: Elective Co	mpulsory
Following Curricula	General Engineering Science (German program, 7 General Engineering Science (German program, 7		-	
y carrieda	Compulsory			
	Data Science: Core Qualification: Elective Compuls	ory		
	Electrical Engineering: Core Qualification: Elective	•		
	Energy and Environmental Engineering: Specialisat		sory	
	Energy Systems: Specialisation Energy Systems: E		-	
	General Engineering Science (English program, 7 s		ering: Elective Con	npulsory
	Green Technologies: Energy, Water, Climate: Spec	alisation Energy Systems: Elective Comp	ulsory	
	Computational Science and Engineering: Specialisa	tion II. Mathematics & Engineering Scien	ce: Elective Compu	lsory
	Renewable Energies: Core Qualification: Compulso	ry		
	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 (small)
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	
Theoretical Electrical Engineering I		Lecture	3	5	
Theoretical Electrical Engineering I		Recitation Section (small)	2	1	
	Prof. Christian Schuster				
Admission Requirements	None				
Recommended Previous	Electrical Engineering I, Electrical Engineering II,	Theoretical Electrical Engineering I			
Knowledge	Mathematics I, Mathematics II, Mathematics III, M	Aathematics IV			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence					
Knowledge	Students are able to explain fundamental		-		
	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.	ine of applications for the theory of time-de	pendent electronia	agrietic fields and a	
Skills	Students are able to apply a variety of procedure	es in order to solve the diffusion and the wa	ave equation for ge	neral time-depende	
	field problems. They can assess the principal ef				
	They can deduce meaningful quantities for the	characterization of fully dynamic fields (wave impedance, s	skin depth, Poyntin	
	vector, radiation resistance, etc.) from given fiel	ds and interpret them with regard to practi	cal applications.		
_					
Personal Competence					
Social Competence	Students are able to work together on subject re during exercise sessions).	elated 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	nation from provided references and relate	this information to	the lecture. They a	
	able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the				
	lectures and exercises that are related to the ex	am. Based on respective feedback, studen	s are expected to a	adjust their individu	
	learning process. They are able to draw con	nections between acquired knowledge a	nd ongoing resea	rch at the Hambu	
	University of Technology (TUHH), e.g. in the area	a of high frequency engineering and optics.			
Mauldeed in H	Independent Chudy Time 110, Chudy Time 1, 1	hung 70			
Workload in Hours Credit points	Independent Study Time 110, Study Time in Lecture 70				
Course achievement	None				
	Written exam				
Examination duration and					
scale					
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Electrical Engir	eering: Compulsor	у	
Following Curricula	Electrical Engineering: Core Qualification: Comp	ulsory			
	Technomathematics: Specialisation III. Engineeri	ng Science: Elective Compulsory			

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 El	ourse 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		

Module M0783: Meas	urements: Metl	nods and Da	ta Processing			
Courses						
Title				Тур	Hrs/wk	СР
EE Experimental Lab (L0781)				Practical Course	2	2
Measurements: Methods and Data	Processing (L0779)			Lecture	2	3
Measurements: Methods and Data	Processing (L0780)			Recitation Section (small)	1	1
Module Responsible	Prof. Alexander Schla	efer				
Admission Requirements	None					
Recommended Previous	principles of mathem	atics				
Knowledge	principles of electrica	l engineering				
Educational Objectives	After taking part succ	essfully, students	have reached the following	ng learning results		
Professional Competence						
Knowledge	The students are able	e to explain the p	urpose of metrology and	the acquisition and proce	essing of measureme	ents. They can deta
	aspects of probability	theory and errors	s, and explain the process	ing of stochastic signals.	Students know meth	ods to digitalize an
	describe measured si	gnals.				
Skills	The students are able	to evaluate prob	lems of metrology and to	apply methods for describ	oing and processing	of measurements.
Personal Competence						
Social Competence	The students solve pr	oblems in small g	roups.			
Autonomy	The students can refl	act their knowledg	ge and discuss and evalua	to their results		
Autonomy	The students carrier	eet their knowledg		te then results.		
Workload in Hours	Independent Study Ti	me 110, Study Tir	me in Lecture 70			
Credit points						
Course achievement		Form	Description			
	Yes 10 %	Excercises				
Examination	Written exam					
Examination duration and	90 min					
scale						
Assignment for the	General Engineering	Science (German	program, 7 semester): Spe	ecialisation Electrical Engi	ineering: Elective Co	mpulsory
Following Curricula						
			rogram, 7 semester): Spe	cialisation Electrical Engin	neerina: Elective Cor	npulsorv
			Engineering Science: Elec	-		
			Defender Liee			

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, Dozenten des SD E, Prof. Alexander Kölpin, Prof. Christian Becker, Prof. Heiko Falk, Prof. Herbert Werner,
	Prof. Rolf-Rainer Grigat, 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: Measurement	s: Methods and Data Processing
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Alexander Schlaefer
Language	DE
Cycle	WiSe
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	ourse 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	

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

Module M0760: Elect	ronic Devices				
Courses					
Title			Тур	Hrs/wk	СР
Electronic Devices (L0720)			Lecture	3	4
Electronic Devices (L0721)			Project-/problem-based Learning	2	2
Module Responsible	Prof. Hoc Khiem Trieu				
Admission Requirements	None				
Recommended Previous	Atomic model and quantum theory, electric	ical currents in solid sta	ate materials, basics in solid-sta	te physics	
Knowledge	Successful participation of Physics for Eng	ineers and Materials in	Electrical Engineering or course	s with equival	ent contents
Educational Objectives	After taking part successfully, students ha	ve reached the following	ng learning results		
Professional Competence					
Knowledge					
	Students are able				
		lunder a la sel na			
	 to represent the basics of semicond 	luctor physics,			
	 to explain the operating principle of 	important semicondu	ctor devices,		
	 to outline device characteristics and 	d equivalent circuits as	well as to explain their derivation	on and	
	the discussion days listing the discussion of the discussion of				
	 to discuss the limitation of device m 	lodels.			
Skills					
	Students are capable				
	 to apply devices in basic circuits, 				
	to realize the physical context and to solve complex problems by oneself				
Personal Competence					
	Students are able to prepare and perform	their lab experiments	in team work as well as to pres	ent and discus	s the results in fro
	of audience.				
4	Churchen berner ander bler berner viere bereide der	- Incored and Discontinues in			
Autonomy Workload in Hours	Students are capable to acquire knowledg Independent Study Time 110, Study Time		Torder to prepare their experim	ents.	
Credit points	6	In Lecture 70			
Course achievement	Compulsory Bonus Form	Description			
	Yes 10 % Subject theoretic practical work	demonstriere Diskussion. [erarbeiten in Kleingruppen Wis en dieses in Form eines Vo Darüber hinaus betreut jede (ersuches mit	Präsentation u
Evamination	Writton oxam	inhaltlich zu d	dem jeweiligen Versuch gehört.		
Examination Examination duration and	Written exam				
scale	120 1111				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Sp	ecialisation Electrical Engineerin	g: Compulsory	,
Following Curricula	Electrical Engineering: Core Qualification:		-	. ,	
	Engineering Science: Specialisation Electri	cal Engineering: Comp	oulsory		
	General Engineering Science (English prog		5 5	, , ,	
	Computational Science and Engineering: S	pecialisation II. Mathe	matics & Engineering Science: E	lective Compu	lsory

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

Courses				
Title		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 semiconducto	r physics		
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence Knowledge	 Students are able to explain how an Students are able to explain the function Students know the fundamental digitation 	ctionality of different MOS devices in electroni alog circuits functions and where they are app ctionality of fundamental operational amplifier ital logic circuits and can discuss their advanta mory circuits and can explain their functionali s for the use of bipolar transistors.	lied. rs and their specification ages 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. 			
Personal Competence Social Competence	 Students are able work efficiently in Students working together in small g 	heterogeneous teams. groups can solve problems and answer profess	sional questions.	
Autonomy	• Students are able to assess their lev	vel of knowledge.		
Workload in Hours	Independent Study Time 124, Study Time i	in Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale	120 mm			
Assignment for the	General Engineering Science (German proc	gram, 7 semester): Specialisation Electrical En	aineerina: Compulsory	/
-		program, 7 semester): Specialisation Mech		
	Compulsory			
	Data Science: Core Qualification: Elective C	Compulsory		
	Electrical Engineering: Core Qualification: C	Compulsory		
	Engineering Science: Specialisation Electric	cal Engineering: Compulsory		
	Engineering Science: Specialisation Mecha	tronics: Compulsory		
	General Engineering Science (English prog	ram, 7 semester): Specialisation Electrical Eng	ineering: Compulsory	
		program, 7 semester): Specialisation Mech	anical Engineering, F	ocus Mechatroni
	Compulsory			
	5 5 7 5 7 5	ram, 7 semester): Specialisation Mechatronics		la su c
		pecialisation II. Mathematics & Engineering Sc	ience: Elective Compu	isory
	Mechanical Engineering: Specialisation Mec			
	Mechatronics: Core Qualification: Compulse	or y		

urse 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 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

^					
Courses					
Fitle	aton (10640)	Typ	Hrs/wk	CP	
Electrical Engineering Project Labor	-	Project-/problem-based Learning	8	6	
Module Responsible					
Admission Requirements		- 11			
	Electrical Engineering I, Electrical Engineering] []			
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence	Arter taking part successivily, students have	reaction are following reacting results			
-	Students are able to give a summary of th	ne technical details of projects in the area of ele	ectrical engine	eering and illustrat	
		f describing and communicating relevant problems			
		cal process of solving practical problems and prese			
Skills	The students can transfer their fundamenta	I knowledge on electrical engineering to the proc	ess 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 concep	btual solutions for non-standardized problems.			
Personal Competence					
Social Competence	•	ed-subject groups in order to independently derive able to effectively present and explain their result	-		
		bility to develop alternative approaches to an			
	independently or in groups and discuss advar		cicculcul c	ingineering probler	
	······································				
Autonomy	Students are capable of independently solvin	g electrical engineering problems using provided li	terature. They	/ are able to fill gap	
	in as well as extent their knowledge using t	the literature and other sources provided by the s	supervisor. Fu	rthermore, they car	
	meaningfully extend given problems and prag	gmatically solve them by means of corresponding s	olutions and c	oncepts.	
	Independent Study Time 68, Study Time in Le	ecture 112			
Credit points	6				
Course achievement					
	Subject theoretical and practical work				
	based on task + presentation				
scale					
-		m, 7 semester): Specialisation Electrical Engineerin	g: Compulsory	/	
Following Curricula	Electrical Engineering: Core Qualification: Cor				
	Engineering Science: Specialisation Electrical	Engineering: Compulsory n, 7 semester): Specialisation Electrical Engineering	r Compulsory		
	Technomathematics: Specialisation III. Engine		. compuisory		

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	Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, power electronics based inverters, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis.
Literature	Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages).

Specialization Energy and Enviromental Engineering

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

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

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science responds to two developments: on the one hand the increasing significance of environmental protection through CO_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.

ourses						
itle			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 ele	ctrical engineering				
Knowledge						
Educational Objectives	After taking part succe	ssfully, students have reache	d the following learning results			
Professional Competence						
Knowledge			tionality of computing systems. It cov	ers the layers from	n the assembly-le	
	programming down to	gates. The module includes th	ne following topics:			
	 Introduction 					
	Combinational lo	ogic: Gates, Boolean algebra,	Boolean functions, hardware synthesis,	combinational net	works	
		: Flip-flops, automata, system	atic hardware design			
	 Technological for 					
	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 					
		-	cacnes CPU, principles of passing data, point-to	point connections	hussos	
		findin the perspective of the t	cro, principles of passing data, point-to	-point connections	, busses	
Skills			rchitect's perspective, i.e., they identify			
			omputers can be built based or			
	collection of few and simple components. They are able to distinguish between and to explain the different abstr today's computing systems - from gates and circuits up to complete processors.					
	today s computing syst	terns - noni 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					
	-		ar, they shall understand the conseque			
	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 I	ow abstraction levels have on	an entire system's performance and to	propose feasible	options.	
Personal Competence						
Social Competence	Students are able to so	olve similar problems alone or	in a group and to present the results a	ccordingly.		
Autonomy	Students are able to ac	cquire new knowledge from sp	ecific literature and to associate this ki	nowledge with othe	er classes.	
Workload in Hours	Independent Study Tim	ne 124, Study Time in Lecture	56			
Credit points	6					
Course achievement	Compulsory Bonus	Form D	escription			
	Yes 10 %	Excercises				
Examination	Written exam					
Examination duration and	90 minutes, contents o	f course and labs				
scale						
-			mester): Specialisation Computer Scien			
Following Curricula			mester): Specialisation Bioprocess Eng	e .	ory	
	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory					
	General Engineering So General Engineering So	1 5	mester): Specialisation Electrical Engin	eering: compulsor	у	

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

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

Course L0321: Computer Eng	gineering
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/EN
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.

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

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

Courses				
Title	1 (1 2 2 2 5)	Тур	Hrs/wk	СР
Fundamentals of Materials Science	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture Lecture	2	2 2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible				_
Admission Requirements				
	Highschool-level physics, chemistry und mathematics			
Knowledge	nighschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowleage	The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. Th for materials and can identify relevant approaches for cha phenomena back to the underlying physical and chemical laws	ally the issues of atom ne students know abou aracterizing specific pr	nic structure, microstructu ut the key aspects of chara	re, phase diagra acterization meth
Skills	The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stree resistance, and to phase transformations such as solidificatio between processing conditions and the materials microstructure material's behavior.	ngth, ductility, and stir n, precipitation, or m	ffness, chemical propertie elting. The students can	s such as corros explain the rela
Personal Competence				
Social Competence				
Autonomy	-			
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement				
	Written exam			
Examination duration and	180 min			
scale				
-	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S			-
Following Curricula	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S			-
	General Engineering Science (German program, 7 semester): S			ng. compuisory
	General Engineering Science (German program, 7 semester). S			
	General Engineering Science (German program, 7 semester): S		incecture. compulsory	
	General Engineering Science (German program, 7 semester): S			
	Data Science: Specialisation Materials Science: Compulsory	•		
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory			
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com	npulsory	d Enviromental Engineerir	na: Compulsory
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp	npulsory pecialisation Energy an	-	
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	pulsory pecialisation Energy an pecialisation Mechanica	al Engineering: Compulsor	
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	polisory pecialisation Energy an pecialisation Mechanica pecialisation Naval Arch	al Engineering: Compulsor hitecture: Compulsory	y
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica	al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory	y
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch	al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory	y
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect	npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch	al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory	y
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect Mechanical Engineering: Core Qualification: Compulsory	npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch	al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory	y
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect	npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch	al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory	y

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 P. Haasen: Physikalische Metallkunde. Springer 1994

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					
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 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				Tun	Hee /under	СР	
Embodiment Design and 3D-CAD (L	0268)			Typ Lecture	Hrs/wk 2	1	
Mechanical Design Project I (L0695				Project-/problem-based Learning	2	2	
Mechanical Design Project II (L0592)				Project-/problem-based Learning	3	2	
Team Project Design Methodology				Project-/problem-based Learning	2	1	
Module Responsible	Prof. Dieter Krause						
Admission Requirements	None						
Recommended Previous							
Knowledge	Fundamentals of Mechanical Engineering Design						
	Mechanics						
		s of Materials Science					
	 Production Er 	igineering					
Educational Objectives	After taking part su	ccessfully, students have re	ached the following	g learning results			
Professional Competence							
Knowledge	After passing the m	odule, students are able to:					
	ovnlain dosig	n quidalinas for machinary	parts o g consider	ing load situation, materials an	d manufactur	ing requirements	
	 describe basi 		parts e.g. consider	ing load situation, materials an		ing requirements	
		s methods of engineering d	esianina				
Skills	After passing the m	odule, students are able to:					
	 independentl 	v create sketches. technica	l drawings and doc	umentations e.g. using 3D CAD).		
		onents based on design gui	-		,		
		alculate) used components,					
	 use methods 	to design and solve engine	ering design tasks	systamtically and solution-orie	nted,		
	 apply creativ 	ity techniques in teams.					
Deveenel Commetence							
Personal Competence	After peoping the m	adula atudanta ara abla ta.					
Social Competence	Alter passing the m	odule, students are able to:					
	 develop and evaluate solutions in groups including making and documenting decisions, 						
	moderate the use of scientific methods,						
	 present and of 	discuss solutions and techni	cal drawings withir	n groups,			
	 reflect the owner 	n results in the work group	s of the course.				
Autonomv	Students are able						
, aconomy							
				nods within the lectures (e.g. wi	ith clickers),		
	 To solve engi 	neering design tasks syster	natically.				
Workload in Hours	Independent Study	Time 40, Study Time in Lec	ture 140				
Credit points	6						
Course achievement		Form	Description		-		
	Yes None	Written elaboration	Konstruktionsp	,			
	Yes None	Written elaboration	Konstruktionsp	,			
	Yes None	Written elaboration	3D-CAD-Prakti				
Francisco March 1	Yes None	Written elaboration	i eamprojekt K	Construktionsmethodik			
Examination	Written exam						
Examination duration and	190						
scale Assignment for the	General Engineering	Science (Corman program	7 comostor): Cro	cialisation Mochanical Engineer	ing: Compute	017/	
Assignment for the Following Curricula				cialisation Mechanical Engineer		-	
i onowing curricula	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory						
		chanical Engineering: Core Qualification: Compulsory					
	-			ulsory			
	Energy and Environmental Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory						
				ialisation Mechanical Engineeri	-		
				ialisation Biomedical Engineeri			
		ring: Core Qualification: Co			Jpa.50	,	
	-	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. 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 De	esign 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 D	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. 		

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 Fundamentals of Fluid Mechanics (L		Typ Lecture	Hrs/wk	CP 4
Fluid Mechanics for Process Engine		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements Recommended Previous	None			
Knowledge	 Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial dif Integration 	fferential equations		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence Knowledge	Students are able to: • explain the difference between differe • give an overview for different applicat		rocess engineering	
Skills	 give an overview for different applications of the Reynolds Transport-Theorem in process engineering explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary condition Skills 		ions	
	notice the dependency between theor	d mechanics by simplifications to archive qu		e.g. by integration
Personal Competence				
<i>Social Competence</i> <i>Autonomy</i>	 are capable to gather information from of the lecture and able to work together on subject relative (e.g. during small group exercises) are able to work out solutions for exert The students are able to search further literature for each topic 	m subject related, professional publications a ted tasks in small groups. They are able to cises by themselves, to discuss the solutions : and to expand their knowledge with this lite nd to evaluate their actual knowledge with th	oresent their results orally and to preser rature,	effectively in Engli
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement		Description		
French atten	Yes 5 % Midterm			
Examination Examination duration and				
scale	5 10015			
	General Engineering Science (German progra	am. 7 semester): Specialisation Process Engi	neering: Compulsory	
Following Curricula	General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra 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	am, 7 semester): Specialisation Energy and E am, 7 semester): Specialisation Green Techn Compulsory e Qualification: Compulsory m, 7 semester): Specialisation Bioprocess En m, 7 semester): Specialisation Energy and En	nviromental Enginee ologies: Compulsory gineering: Compulso nviromental Engineer	ering: 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. 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
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. 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		Typ	Hrs/wk	СР
Electrical Machines and Actuators (L0293)	Typ 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 com	plexe numbers, integrals, differentials		
Knowledge				
	Basics of electrical engineering and mech	nanıcal engineering		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the ba	sic principles of electric and magnetic fields.		
	These are described that four this so of the			
		e standard types of electric machines and pre		
	from the power grid to the driven engine.	drives they can explain the major parameters of th	le energy eniciency	of the whole syst
	nom the power gha to the unven engine.			
Skills	Students arw able to calculate two-dime	ensional electric and magnetic fields in particular	ferromagnetic circ	uits with air gap.
	this they apply the usual methods of the	design auf electric machines.		
	They can calulate the operational perfor	mance of electric machines from their given cha	racteristic data an	d selected quantit
		e usual equivalent circuits and graphical methods.	racteristic data an	a sereccea quarra
Personal Competence				
Social Competence	none			
		late electric and magnatic fields for applications.	They are able to a	nalvse independer
		machines from the charactersitic data and theyc		
	and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Design of four machines and actuators, r	eview of design files		
scale				
Assignment for the	General Engineering Science (German pr	ogram, 7 semester): Specialisation Energy and En	viromental Enginee	ering: Compulsory
Following Curricula	General Engineering Science (German pr	ogram, 7 semester): Specialisation Electrical Engir	neering: Elective Co	ompulsory
		ogram, 7 semester): Specialisation Mechanical Eng		
		program, 7 semester): Specialisation Mechanica	I Engineering, Foo	cus Energy Syster
	Compulsory	-		
		program, 7 semester): Specialisation Mechan	ical Engineering,	Focus Mechatroni
	Compulsory	agram 7 competer), Specialization Machanical En	aincoring Focus Th	hooratical Machani
	Engineering: Elective Compulsory	ogram, 7 semester): Specialisation Mechanical En	gineering, rocus ri	
	Digital Mechanical Engineering: Core Qua	alification: Compulsory		
	Electrical Engineering: Core Qualification			
	Energy and Environmental Engineering: (
	5, 5 5	gram, 7 semester): Specialisation Electrical Engin	eering: Elective Cor	mpulsory
		gram, 7 semester): Specialisation Energy and Env	-	
	General Engineering Science (English pro	ogram, 7 semester): Specialisation Mechanical Eng	ineering: Elective C	Compulsory
	Computational Science and Engineering:	Specialisation Engineering Sciences: Elective Com	pulsory	
	Logistics and Mobility: Specialisation Eng	ineering Science: Elective Compulsory		
	Mechanical Engineering: Core Qualification	on: Elective Compulsory		
	Mechatronics: Core Qualification: Compu	lsorv		

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 ha	ave reached the following learning results		
Professional Competence				
Knowledge	efficiency. They can explain the issues oc distribution and power trading wih reg applicable to many energy systems in g	dents can provide an overview of characteristics curring in this context. Furthermore, they can ex lard to subject-related contexts. The students eneral, especially for renewable energy systems tal benefits from the use of such systems.	plain details of powe can explain these	er generation, pov aspects, which
Skills	///s Students are able to apply methodologies for detailed determination of energy demand or energy production for various energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and des under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energy		ally and design th rules, also for	
Devenuel Commentence	and to put them them into the right conte	ext.		
Personal Competence	The shudents are able to each as a witch	In the share of the second terms and the second terms with second s		
Social Competence		le technical alternatives and to assess them wi allows them to make an effective contribuition to		
Autonomy	Students can independently exploit sour	rces , acquire the particular knowledge about th	e subject area and	l transform it to i
,	questions.			
Workload in Hours	Independent Study Time 96, Study Time i	in Lecture 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 pro	ogram, 7 semester): Specialisation Energy and En	viromental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German pro	ogram, 7 semester): Specialisation Process Engine	eering: Compulsory	
	General Engineering Science (German	program, 7 semester): Specialisation Mechanic	al Engineering, Foc	us Energy Syste
	Elective Compulsory			
	General Engineering Science (German)	program, 7 semester): Specialisation Mechanic	al Engineering, Foc	us Energy Syste
	Compulsory	• • • • • •		
		ecialisation Civil Engineering: Elective Compulsor	v	
		ecialisation Traffic and Mobility: Elective Compulsion		
			-	
		ecialisation Water and Environment: Elective Com	pulsory	
	Energy and Environmental Engineering: C			
	General Engineering Science (English pro	gram, 7 semester): Specialisation Energy and Env	/iromental Engineer	ing: Compulsory
	General Engineering Science (English p	program, 7 semester): Specialisation Mechanica	al Engineering, Foc	us Energy Syste
	Elective Compulsory			
	General Engineering Science (English pro	gram, 7 semester): Specialisation Process Engine	ering: Elective Com	pulsory

Course L0316: Power Industry	
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 electricity generation of electrical energy classic" 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 Cost and efficiency calculation
Literature	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 10212, Bonowable En	
Course L0313: Renewable En	
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

Course L1434: Renewable En	ergy			
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				Тур)	Hrs/wk	C C	СР
Practical Course: Measurement and	d Control Systems (L1119	9)			tical Course	2	-	2
Measurement Technology for Mechanical Engineering (L1116)		Lec	ture	2		3		
Measurement Technology for Mech	anical Engineering (L112	18)		Rec	itation Section (large)	1		1
Module Responsible	Prof. Thorsten Kern							
Admission Requirements	None							
Recommended Previous	Basic knowledge of p	hysics, chemis	try and electrica	l engineering				
Knowledge								
Educational Objectives	After taking part succ	essfully, stude	nts have reache	d the following le	arning results			
Professional Competence								
Knowledge	Students are able to Calibration, Static an					nology (Quantities	s and Ur	nits, Uncertaiı
	They can outline the Temperature, mecha				ent kinds of quantit	ies to be maesur	red (Elec	ctrical Quantil
	They can describe im	portant metho	ds of chemical A	nalysis (Gas Sen	sors, Spectroscopy,	Gas Chromatogra	aphy)	
Skills	Students can select s	uitable measu	ring methods to	given problems a	nd can use refering	measurement de	evices in	practice.
	The students are able	e to orally exp	lain issues in the	e subject area of	measurement tech	nology and soluti	on appro	oaches as wel
	place the issues into	the right conte	xt and application	on area.				
Personal Competence								
-	Students can arrive a	t work results	in groups and do	ocument them in	a common report.			
-	Students can arrive a	t work results	in groups and do	ocument them in	a common report.			
Social Competence	Students can arrive a Students are able to t							
Social Competence Autonomy		familiarize ther	nselves with new	w measurement t				
Social Competence Autonomy	Students are able to the Independent Study Ti	familiarize ther	nselves with new	w measurement t				
Social Competence Autonomy Workload in Hours	Students are able to the students are able to the study Till of the study Till of the study Till of the study	familiarize ther ime 110, Study Form	nselves with new Time in Lecture	w measurement t				
Social Competence Autonomy Workload in Hours Credit points	Students are able to I Independent Study Ti 6	familiarize ther ime 110, Study Form Subject th	nselves with new Time in Lecture c eoretical and	w measurement t 2 70				
Social Competence Autonomy Workload in Hours Credit points Course achievement	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None	familiarize ther ime 110, Study Form Subject th practical wor	nselves with new Time in Lecture eoretical and 'k	w measurement t 2 70				
Social Competence Autonomy Workload in Hours Credit points Course achievement	Students are able to the students are able to the study Till of the study Till of the study Till of the study	familiarize ther ime 110, Study Form Subject th practical wor	nselves with new Time in Lecture eoretical and 'k	w measurement t 2 70				
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar	familiarize ther ime 110, Study Form Subject th practical wor	nselves with new Time in Lecture eoretical and 'k	w measurement t 2 70				
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar	familiarize ther ime 110, Study Form Subject th practical wor	nselves with new Time in Lecture eoretical and 'k	w measurement t 2 70				
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ	nselves with new r Time in Lecture eoretical and rk rk an program, 7 se	w measurement t	echnologies.			
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ	nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se	w measurement t	echnologies. isation Mechanical B isation Biomedical E	ingineering: Com	pulsory	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ	nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se	w measurement t 2 70 Description emester): Special emester): Special emester): Special	echnologies. isation Mechanical B isation Biomedical E	ingineering: Com	pulsory	: Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ gineering: Cor	nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se	w measurement t	echnologies. isation Mechanical B isation Biomedical E isation Energy and B	ingineering: Com	pulsory	: Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering General Engineering Digital Mechanical En Energy and Environm	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ gineering: Cor iental Engineer	nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se	w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulso	echnologies. isation Mechanical B isation Biomedical E isation Energy and B	ingineering: Com	pulsory	: Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science:	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ science (Germ ugineering: Cor ugineering: Cor ugineering: Cor ugineering: Cor ugineering: Cor	nselves with new rime in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C	w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulsory ication: Compulsory	echnologies. isation Mechanical E isation Biomedical E isation Energy and f	ingineering: Com	pulsory	: Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science:	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ specialisation Specialisation	nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi	w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulsory ineering: Compulsory	echnologies. isation Mechanical E isation Biomedical E isation Energy and f pry sory	ingineering: Com	pulsory	: Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science:	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ specialisation Specialisation Specialisation	mselves with new Time in Lecture eoretical and k rk an program, 7 se an progra	w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulsory ication: Compulsory ineering: Compulsory neering: Elective	echnologies. isation Mechanical E isation Biomedical E isation Energy and E isation Energy and E sory Compulsory	ingineering: Com	pulsory	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ Science (Germ specialisation Specialisation Specialisation Science (Englis	nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi th program, 7 se	w measurement t 2 70 Description eemester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Compulsory ineering: Elective mester): Speciali	echnologies. isation Mechanical E isation Biomedical E isation Energy and E ory Sory Compulsory sation Energy and E	ingineering: Com Enviromental Eng nviromental Engi	pulsory ineering neering:	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ Science (Germ specialisation Specialisation Specialisation Science (Englis Science (Englis	nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi th program, 7 se th program, 7 se	w measurement t 2 70 Description eemester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Compulsory ineering: Elective mester): Speciali mester): Speciali	echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E	ingineering: Com Enviromental Eng nviromental Engi ngineering: Comp	pulsory ineering neering: pulsory	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis	nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi h program, 7 se th program, 7 se	w measurement t 2 70 Description emester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Elective mester): Speciali mester): Speciali mester): Speciali	echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E sation Biomedical Er	ingineering: Com Enviromental Eng nviromental Engi ngineering: Comp ngineering: Comp	pulsory ineering neering: pulsory	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering	familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis	nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi ih program, 7 se ih program, 7 se ih program, 7 se	w measurement t 2 70 Description emester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Elective mester): Speciali mester): Speciali mester): Speciali mester): Speciali	echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E sation Biomedical Er sation Mechatronics	ingineering: Com Enviromental Engi nviromental Engi ngineering: Comp ngineering: Comp : Compulsory	neering pulsory neering: pulsory pulsory	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering	familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis	nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi ih program, 7 se ih program, 7 se ih program, 7 se ih program, 7 se ih program, 7 se	w measurement t 2 70 Description emester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Elective mester): Speciali mester): Speciali mester): Speciali mester): Speciali mester): Speciali mester): Speciali	echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E sation Mechatronics sation Mechatronics	ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp	neering: pulsory pulsory pulsory pulsory	Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering	familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis	mselves with new Time in Lecture eoretical and tk rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi ih program, 7 se ih program, 7 se	w measurement t 2 70 Description Description Description Description Description Description Description Description Special mester): Special mester): Special	echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sory Compulsory sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E	ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp ngineering: Electi	neering: pulsory pulsory pulsory pulsory	Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Sciences Scien	familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis	mselves with new Time in Lecture eoretical and tk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi Biomedical Engi sh program, 7 se sh program, 7 se	w measurement t	echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sory Compulsory sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E	ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp ngineering: Electi	neering: pulsory pulsory pulsory pulsory	Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Science:	familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor do practical wor Science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis	mselves with new Time in Lecture eoretical and tk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi Biomedical Engi sh program, 7 se sh progra	w measurement t	echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sory Compulsory sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E	ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp ngineering: Electi	neering: pulsory pulsory pulsory pulsory	Compulsory
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Sciences Scien	familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor do practical wor science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis	mselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se by core Qualification: C Mechanical Engi Biomedical Engi bi program, 7 se ih	w measurement t	echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E sation Biomedical E sation Biomedical E sation Biomedical E	ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Electi mpulsory	pulsory ineering neering: pulsory pulsory pulsory ve Comp	Compulsory

	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					
СР	3				
	of. 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				
	i Data Transmission				
	3 Measurement of Nonelectric Quantities				
	3.1 Temperature				
	.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		Tun	Hrs/wk	СР
Computational Fluid Dynamics I (L	235)	Typ Lecture	2	3
Computational Fluid Dynamics I (L0419)		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous				
Knowledge	Mathematical Methods for Engineers			
	 Fundamentals of Differential/integral calcul 	lus and series expansions		
Educational Objectives	After taking part successfully, students have reach	hed the following learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of	f partial differential equations.		
Skills	The students are able develop appropriate numer	ical integration in space and time for the go	overning partial d	ifferential equatio
	They can code computational algorithms in a strue	ctured way.		
Personal Competence				
	The students can arrive at work results in groups	and document them.		
social competence				
Διιτοποπγ	The students can independently analyse approach	hes to solving specific problems		
Autonomy	The stadents can independently analyse approach	ies to solving specific prosterio.		
	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program, 7	<pre>semester): Specialisation Mechanical Engin</pre>	neering, Focus Th	eoretical Mechani
Following Curricula	Engineering: Elective Compulsory			
	General Engineering Science (German program	, 7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	Engineering: Elective Compulsory			
	General Engineering Science (German program, Elective Compulsory	, / semester): Specialisation Mechanical	Engineering, Foc	us Energy Syster
	General Engineering Science (German program, 7	semester). Specialisation Naval Architectur	e: Compulson	
	General Engineering Science (German program, 7			ring: Compulsory
	Energy Systems: Technical Complementary Cours		Strenta Engineer	g. compuisory
	General Engineering Science (English program, 7		mental Engineeri	ing: Compulsorv
	General Engineering Science (English program,		-	• • •
	Elective Compulsory	• • • • • • • • • • • • • • • • • • • •	5 5	3, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	General Engineering Science (English program, 7	semester): Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (English program,	•		us Aircraft Syste
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation Energy Sys	stems: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft Sy	stems Engineering: Elective Compulsory		
	Naval Architecture: Core Qualification: Compulsor	У		

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.		
	 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		

Module M1275: Envir	onmental Tech	nology			
Courses					
Fitle			Typ	Hrs/wk	CP
Practical Exercise Environmental To Environmental Technologie (L0326	5,		Practical Course Lecture	1 2	1 2
Module Responsible	1	si++	Lecture	L	2
Admission Requirements					
Recommended Previous		manic/organic chemistry	and biology		
Knowledge	i undumentais or mor	gunic, organic chemistry	and biology		
	After taking part succ	ressfully students have i	reached the following learning results		
Professional Competence	Arter taking part sact	costany, statents have i	reaction and the following rearring results		
	With the completion	of this modul the student	ts obtain profound knowledge of environm	ental technology. They	are able to descri
Knowledge			nt. Students can give an overview of scier		
		nem to related methods.			ear mey ear expr
Skills			anagement and mitigation measures for		-
	-		ssess the potential of pollutants to migra		
			conmental Technology contributes to susta	inable development, a	and they can pres
	and defend these opi	inons in front of and agai	nst the group.		
Personal Competence					
Social Competence	The students are able	e to discuss the various t	echnical and scientific tasks, both subject-	specific and multidisci	plinary. They are a
	to develop different a	approaches to the task as	s a group as well as to discuss their theore	tical or practical imple	mentation.
Autonomy	Students can indepen	ndently exploit sources a	bout of the subject, acquire the particular	knowledge and tranfer	r it to new problem
Workload in Hours	Independent Study T	ime 48, Study Time in Le	ecture 42		
Credit points	3				
Course achievement	Compulsory Bonus	Form	Description		
	Yes None	Subject theoretical	and		
		practical work			
	Written exam				
Examination duration and	1 hour				
scale					
-			m, 7 semester): Specialisation Process Eng	-	
Following Curricula			m, 7 semester): Specialisation Bioprocess		
			m, 7 semester): Specialisation Energy and	Enviromental Enginee	ring: Compulsory
		ng: Core Qualification: El			
	3,	5 5	Qualification: Compulsory		
			n, 7 semester): Specialisation Bioprocess E		
			n, 7 semester): Specialisation Energy and I	-	
			n, 7 semester): Specialisation Process Engi	neering: Elective Com	puisory
	FIOLESS Engineering:	Core Qualification: Elect	ive compulsory		

ourse L1387: Practical Exercise Environmental Technology		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt, Dr. Isabel Höfer	
Language	DE	
Cycle	SoSe	
Content	The practical course Environmental Engineering currently consists of 6 experiments, which deal with the different focal points of environmental engineering in the areas of air, water, soil, environment, biomass and noise. The following experiments are carried out for this purpose: Determination of the calorific value of biomass, soil purification, waste water treatment, noise emissions, plastic waste, biowaste. Translated with www.DeepL.com/Translator (free version) 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		

Course L0326: Environmenta	I Technologie	
Тур	Lecture	
Hrs/wk		
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Martin Kaltschmitt, Dr. Isabel Höfer	
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				
ïtle		Тур	Hrs/wk	СР
hermal Separation Processes (L01		Lecture	2	2
hermal Separation Processes (L01		Recitation Section (small)	2	2 1
hermal Separation Processes (L01 eparation Processes (L1159)	41)	Recitation Section (large) Practical Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics I			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge				
	 The students can distinguish and descriation The students develop an understanding fenergy demand of a process, the possibilitient They have good knowledge of designing not state the students of the students and the state the students are students. 	or the course of concentration during a ties of energy saving, and the selection o	separation process, f separation systems	the estimation of t
Skills	 Using the gained knowledge the students close the associated energy and material The students can use different graphica theoretical stages required They can select and design a basic type disadvantages of the process The students are capable to obtain indep tables) They can calculate continuous and discontered the students are able to prove their theore the students are able to discuss the theore colloquium. 	balances I methods for the designing of a separ e of thermal separation process for a g endently the needed material properties tinuous processes etical knowledge in the experimental lab	ation process and d iven case based on from appropriate so work.	lefine the amount the advantages a purces (diagrams a
Personal Competence Social Competence	 The students can work technical assignment 			utorial
Autonomy	 The students are able to carry out practical lab work in small groups and organize a functional division of labor betwee them. They are able to discuss their results and to document them scientifically in a report. 			
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ıre 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calculation	ons		
Assignment for the Following Curricula	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7	7 semester): Specialisation Bioprocess E 7 semester): Specialisation Green Techn m, 7 semester): Specialisation Green 7 semester): Specialisation Energy and E pulsory alification: Elective Compulsory	ngineering: Compulso ologies, Focus Renew Technologies, Focus nviromental Enginee	able Energy: Elect Renewable Energ ring: Compulsory

Process Engineering: Core Qualification: Compulsory

L

Course L0118: Thermal Sepa	iration Processes
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
	WiSe
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 separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

ourse 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 processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students.
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

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
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
	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 car 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
Literature	 Energy demand of separation processes Advance overview of separation processes Selection of separation processes 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 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

Courses				
Title	Ту	'p	Hrs/wk	СР
Environmental Assessment (L0860)		cture	2	2
Environmental Assessment (L1054)	Rec	citation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and biology			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	With the completion of this module the students acquire in-dep environmental problems which might occur from production proces about the methodological diversity and are competent in dealing wii impacts. Besides the students are able to estimate the complexity of difficulties with their measurement.	sses, projects or construction ith different methods and inst	measures. The ruments to asse	y have knowled ess environment
Skills	afficulties 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 can out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database EcoInver 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 and scientific to develop jointly different solutions and to discuss their theoretic topics, the students receive insights into the multi-layered issues of Their sensitivity and consciousness towards these subjects are rais social responsibilities in their role as engineers.	ical or practical implementat f the environment protection	ion. Due to the and the concep	e selected lecture selected lecture selected lecture selected lecture selected lecture selected sele
Autonomy	The students learn to research, process and present a scientific t scientific to scientific work. They can solve an environmental problem in a busine			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Credit points	3			
Course achievement				
Examination				
Examination duration and				
scale				
	General Engineering Science (German program, 7 semester); Specia	alisation Process Engineering:	Elective Compu	lsorv
3	General Engineering Science (German program, 7 semester): Specia General Engineering Science (German program, 7 semester): Specia	<u> </u>		,
	General Engineering Science (German program, 7 semester): Specia		-	
	Bioprocess Engineering: Core Qualification: Elective Compulsory		2	
	Energy and Environmental Engineering: Core Qualification: Compuls	ory		
	General Engineering Science (English program, 7 semester): Special		g: Elective Com	pulsory
	General Engineering Science (English program, 7 semester): Speciali		-	
	General Engineering Science (English program, 7 semester): Speciali Process Engineering: Core Qualification: Elective 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	WiSe/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	Il 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	WiSe
Content	Presentation and application of free software programs in order to understand the concepts of environmental
	assessment methods better.
	Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation.
Literature	Power point Präsentationen

Module M0538: Heat	and Mass Transfer			
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				
	After taking part successfully, students have reached t	he following learning results		
Professional Competence Knowledge				
Skills	 heat exchanger, chemical reactors). They are capable of distinguish and characterize transfer and thermal radiation. The students have the ability to explain the qualitative and quantitative by using suitable may an addition the analogy between here. They are able to depict the analogy between here and to balance the corresponding energy and may and to calculate the corresponding heat flows. Using dimensionless quantities, the students care. They are able to distinguish between diffusion, for the description and design of apparatus (e.g.) In this context, the students are capable to choor application considering their advantages and distinguish betw, steady-state. The students are capable to connect their k particular the courses thermodynamics, fluid r problems. 	physical basis for mass transfer in or ass transfer theories. at- and mass transfer and to describe of boundaries for a given transport pro- ass flow, respectively. r problems (e.g. heated chemical read on execute scaling up of technical proce convective mass transition and mass f extraction column, rectification colum use and design fundamental types of h iadvantages, respectively. e and non-steady-state processes in pr mowledge obtained in this course	detail and to de complex linked pu oblem by using th ctors, temperatur esses or apparatu cransfer. They can in). eat and mass exi occedural apparat with knowlegde	scribe mass tran rocesses in detail. he gained knowle re alteration in flu is. n use this knowled changer for a spec- tus. of other courses
Personal Competence Social Competence	 The students are capable to work on subject-sp manner to tutors and other students. 	ecific challenges in teams and to pre	sent the results o	orally in a reasona
Autonomy	 The students are able to find and evaluate neces They are able to prove their level of knowled system, exam-like assignments) and on this bas 	ge during the course with accompan	ying procedure	continuously (clic
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	5		
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 sem	ester): Specialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering Science (German program, 7 sem			ory
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem		omental Enginee	ering: Compulsory
	Bioprocess Engineering: Core Qualification: Compulsor			
	Energy and Environmental Engineering: Core Qualificat		ering: Compulse	n/
	General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme			-
	General Engineering Science (English program, 7 seme			g. compuisory
	Green Technologies: Energy Water Climate Core Qua	lification: Compulsory		
	Green Technologies: Energy, Water, Climate: Core Qua Technomathematics: Specialisation III. Engineering Sci			

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

Course L0102: Heat and 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
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 Heinric	h				
Admission Requirements	None					
Recommended Previous	keine					
Knowledge						
Educational Objectives	After taking part su	ccessfully, students ha	ve reached the following	g learning results		
Professional Competence						
Knowledge	After successful cor	mpletion of the module	students are able to			
	 name and ex 	plain processes and u	nit-operations of solids	process engineering.		
			ibutions and to discuss			
Skills	Students are able to	0				
				ocessing according to the d	esired solids prop	perties of the prod
			ehavior in solids process	ing steps		
	 document th 	eir work scientifically.				
Personal Competence						
Social Competence	The students are a	able to discuss scienti	fic topics orally with ot	her students or scientific p	ersonal and to o	develop solutions
	technical-scientific					
Autonomy	Students are able to	o analyze and solve qu	estions regarding solid	particles independently.		
Workload in Hours	Indopondont Study	Time 110, Study Time	in Locturo 70			
Credit points		Time 110, Study Time	III Lecture 70			
Course achievement	Compulsory Bonus	Form	Description			
course acmevement	Yes None	Written elaboration		(pro Versuch ein Bericht) à	5-10 Seiten	
Examination	Written exam			•		
Examination duration and	90 minutes					
scale						
Assignment for the	General Engineerin	g Science (German pro	gram, 7 semester): Spe	cialisation Process Engineer	ing: Compulsory	
Following Curricula	-		-	cialisation Bioprocess Engin		ory
2	-		-	ecialisation Green Technolo		-
	Engineering: Electiv		5			
			gram, 7 semester): Spe	cialisation Energy and Envir	omental Enginee	ring: Compulsory
	-	ering: Core Qualification	-		5	,
		-	ore Qualification: Electiv	e Compulsory		
				ialisation Bioprocess Engine	ering: Compulso	ry
	-			ialisation Energy and Enviro		-
	-			ialisation Process Engineeri	-	5
	General Engineerin	y science (Enulish broc				
	-		te: Specialisation Water	-	ing. compaisory	

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 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 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.

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.

Courses				
		T	Hara karda	
Title Discrete Algebraic Structures (L01)	64)	Typ Lecture	Hrs/wk	СР 3
Discrete Algebraic Structures (LOI)		Recitation Section (small)		3
	Prof. Karl-Heinz Zimmermann			
Admission Requirements				
	Mathematics from High School.			
Knowledge	· · · · · · · · · · · · · · · · · · ·			
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	The students know the important basics of	f discrete algebraic structures including elem	entary combinatorial	structures, monoid
	groups, rings, fields, finite fields, and vector	r spaces. They also know specific structures li	ke sub sum-, and qu	lotient structures an
	homomorphisms.			
Skills	Students are able to formalize and analyze basic discrete algebraic structures.			
Personal Competence				
Social Competence	Students are able to solve specific problems	s alone or in a group and to present the result	ts accordingly.	
Autonomy	Students are able to acquire new knowled	dge from specific standard books and to as	sociato the acquires	t knowledge to oth
Autonomy	classes.	age from specific standard books and to as	sociate the acquired	Rhowledge to othe
Workload in Hours	Independent Study Time 124, Study Time ir	n 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	ram, 7 semester): Specialisation Computer So	ience: Compulsory	
Following Curricula	Computer Science: Core Qualification: Com	pulsory		
	Data Science: Core Qualification: Compulso	ry		
	General Engineering Science (English progr	am, 7 semester): Specialisation Computer Sci	ence: Compulsory	
	Computational Science and Engineering: Co	pre Qualification: Compulsory		
	Orientierungsstudium: Core Qualification: E	lective 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/EN	
Cycle	WiSe	
Content		
Literature		

Course L0165: Discrete Algebraic Structures		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Karl-Heinz Zimmermann	
Language	DE/EN	
Cycle	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 deals with the foundations of the funct	encling of computing systems. It can	re the lower from	the ecompluie
Kilowieuge	This module deals with the foundations of the function programming down to gates. The module includes the		is the layers from	i the assembly-le
	Introduction			
	Combinational logic: Gates, Boolean algebra, Bo Sequential logic: Flip flops, automata, systemata	-	combinational netv	vorks
	 Sequential logic: Flip-flops, automata, systemat Technological foundations 			
	Computer arithmetic: Integer addition, subtract	ion, multiplication and division		
	Basics of computer architecture: Programming		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, c	aches		
	• Input/output: I/O from the perspective of the CF	U, principles of passing data, point-to-p	point connections,	busses
Skills	The students perceive computer systems from the arc	hitect's perspective, i.e., they identify	the internal struct	ure and the physi
	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	p to complete processors.		
	After successful completion of the module, the stude	ents are able to judge the interdenend	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 a	n entire system's performance and to	propose feasible o	ptions.
Personal Competence				
	Students are able to solve similar problems alone or ir	a group and to present the results acc	cordinaly	
Social competence	students are usie to solve similar problems alone or 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 5	6		
Credit points				
Course achievement	Compulsory Bonus Form De	scription		
	Yes 10 % Excercises			
	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
	General Engineering Science (German program, 7 sen	actor): Specialization Computer Science	co: Compulsory	
	General Engineering Science (German program, 7 sen			rv
, ,	General Engineering Science (German program, 7 sen			. ,
	General Engineering Science (German program, 7 sen	nester): Specialisation Electrical Engine	ering: Compulsory	
	General Engineering Science (German program, 7 sen	nester): Specialisation Biomedical Engir	neering: Compulso	ry
	General Engineering Science (German program, 7 sen	nester): Specialisation Energy and Envi	romental Engineer	ing: Compulsory
	General Engineering Science (German program, 7 sen	nester): Specialisation Process Engineer	ring: Compulsory	
	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering, F	ocus Mechatroni
	Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanica	al Engineering, F	ocus Biomechani
	Compulsory			
			Engineering, Foc	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	us Aircraft Syste
	Engineering: Compulsory	•		
	Engineering: Compulsory General Engineering Science (German program,	•		
	Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory	7 semester): Specialisation Mechani	cal Engineering,	Focus Materials
	Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser	7 semester): Specialisation Mechani	cal Engineering,	Focus Materials
	Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory	7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi	cal Engineering, neering, Focus Th	Focus Materials
	Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory	7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi	cal Engineering, neering, Focus Th	Focus Materials
	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 Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng	cal Engineering, neering, Focus Th gineering, Focus P	Focus Materials eoretical Mechani roduct Developm
	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	7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	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 Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	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 General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 senation program, 7 senation	7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	Focus Materials eoretical Mechani roduct Developm us Energy Syster
	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 General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory	7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	Focus Materials eoretical Mechan roduct Developm us Energy System
	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 General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory	7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu	Focus Materials eoretical Mechan roduct Developm us Energy System
	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 General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory	7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory	Focus Materials eoretical Mechan roduct Developm us Energy System
	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 General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem	7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical nester): Specialisation Mechanical nester): Specialisation Civil Engineering	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory	Focus Materials eoretical Mechan roduct Developm us Energy System
	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 General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory	7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering ester): Specialisation Electrical Enginee ester): Specialisation Civil Engineering:	cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory Compulsory Compulsory	Focus Materials 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 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/EN
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	gineering
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/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Turn	Hre /w/r	СР
Graph Theory and Optimization (L1	046)	Typ Lecture	Hrs/wk 2	3
Graph Theory and Optimization (L1		Recitation Section (small)	2	3
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous				
Knowledge	Discrete Algebraic Structures			
	Mathematics I			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge				
		in Graph Theory and Optimization. They are a	ble to explain the	em using appropria
	examples.			
		s between these concepts. They are capable	of illustrating the	ese connections w
	the help of examples.			
	 They know proof strategies and can repr 	roduce them.		
Skills				
		h Theory and Optimization with the help of	the concepts stu	idied in this cours
	Moreover, they are capable of solving th			
		further logical connections between the conce		
		develop and execute a suitable approach, a	ind are able to ci	ritically evaluate t
	results.			
Personal Competence				
Social Competence	 Students are able to work together in te 	ams. They are capable to use mathematics as	a common langua	age.
		concepts according to the needs of their coo		
	design examples to check and deepen t			
	5	5 .		
Autonomy				
		understanding of complex concepts on their of	own. They can sp	ecify open questic
	precisely and know where to get help in			
		sistence to be able to work for longer period	ls in a goal-orient	ted manner on ha
	problems.			
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Computer Science	e: Compulsory	
Following Curricula	Computer Science: Core Qualification: Compute	sory	-	
	Computer Science: Core Qualification: Compute	sory		
	Data Science: Core Qualification: Compulsory			
	General Engineering Science (English program	, 7 semester): Specialisation Computer Science	e: Compulsory	
	Logistics and Mobility: Specialisation Engineeri	ng Science: Elective Compulsory		
	Technomathematics: Specialisation I. Mathema	atics: Elective Compulsory		

urse L1046: Graph Theory	•
	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/EN
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 T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Algorithmen - Eine Einführung, Oldenbourg, 2013 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	ourse 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/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Stochastics (L0777)		Lecture	2	4
Stochastics (L0778)		Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous	Calculus			
Knowledge	 Discrete algebraic structures (combinatorics) 			
	Propositional logic			
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	Students can explain the main definitions of prob			-
	variables, events, dependence, independence as		-	
	distributions, density functions). Students can de		•	
	deviation, and moments. Students can define decis		÷ .	
	chain rule or Bayesian networks). Algorithms, or est			
	an estimator, etc. Student can describe the main i		-	-
Chille	computation problem for stochastic processes. Stud			
SKIIIS	Students can apply algorithms for solving decision enough in various application contexts, i.e., students			
	enough in various application contexts, i.e., students	s can derive estimators and judge whethe	a they are applic	able of feliable.
Personal Competence				
Social Competence	- Students are able to work together (e.g. on thei	r regular home work) in heterogeneousl	y composed tea	ms (i.e., teams fro
	different study programs and background knowledge	e) and to present their results appropriat	ely (e.g. during e	exercise class).
Διιτοροφγ	- Students are capable of checking their understa	anding of complex concepts on their ow	n They can so	ecify open questio
Autonomy	precisely and know where to get help in solving ther		in mey can sp	certy open questio
	- Students can put their knowledge in relation to the	contents of other lectures.		
	- Students have developed sufficient persistence to	be able to work for longer periods in a go	al-oriented mann	er on hard problem
		50		
	Independent Study Time 124, Study Time in Lecture	56		
Credit points Course achievement				
Examination				
Examination duration and scale	120 min			
Assignment for the	Concrol Engineering Science (Cormon program 7 or	masterly Englishing Computer Science	a Compulsor	
Assignment for the Following Curricula	General Engineering Science (German program, 7 se Computer Science: Core Qualification: Compulsory	emester): specialisation Computer Scienc	e. compulsory	
Following Curricula	Data Science: Core Qualification: Compulsory			
	General Engineering Science (English program, 7 se	mester): Specialisation Computer Science	: Compulsory	
	Computational Science and Engineering: Core Qualif		. comparisony	
	Computational Science and Engineering: Core Qualif			
	Logistics and Mobility: Specialisation Engineering Sc			
	Theoretical Mechanical Engineering: Core Qualificati			

Course L0777: Stochastics	
Тур	Lecture
Hrs/wk	2
СР	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	
	1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008
	 Stochastik f ür Informatiker, D ümbgen, L., Springer 2003 Stotistik Dan Wassers Datasashus, Schemelin L, K ünstland D, Dissett L, Tute, C., Springer 2010
	3. Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010
	 Stochastik, Georgii, HO., deGruyter, 2009 Brobability and Pandom Processor, Grimmett, G., Stirzakor, D., Oxford University Processor, 2001
	 Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001 Programmieren mit R, Ligges, U., Springer 2008
	o. rrogrammeren mir n, Ligges, o., Springer 2000

Course L0778: Stochastics	
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Christian Seifert
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Automata Theory and Formal Lang		Lecture	2	4
Automata Theory and Formal Lang		Recitation Section (small)	2	2
Module Responsible				
Admission Requirements				
	Participating students should be able to			
Knowledge	- specify algorithms for simple data struct	tures (such as, e.g., arrays) to solve computational	problems	
	apply propositional lagis and produces.	lania fay ana situ ing and understanding mathematic	al avaafa	
	- apply propositional logic and predicate i	logic for specifying and understanding mathematic	ai proois	
	- apply the knowledge and skills taught in	n the module Discrete Algebraic Structures		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence		5 5		
-	Students can explain syntax, semantics	, and decision problems of propositional logic, an	d they are able to	o give algorithms
		n show correspondences to Boolean algebra. Stu	-	
		ropositional logic, and therefore, the students car		
		ns for this representation formalism. Students car		-
		problem. Students can also describe syntax, semar		
		heir application areas. The participants of the cou		
		s to logic and formal grammars. The spectrum t		
		e automata and pushdown automata to Turing more expressive than determinism. They are als		
		d, in addition, students can transform decision prob		
		nderstand that some formalisms easily induce algo		
		ies. Students can describe the relationships betwee		
	or grammars.	es. stadents can desense the relationships betwee		i us iogic, uutoin
	or granmars.			
Skills	Students can apply propositional logic as	well as predicate logic resolution to a given set of	formulas Student	s analyze annlicat
		Il logic, predicate logic, or temporal logic formulas		
		rticular application problem, and they can demons		-
		Students can also transform nondeterministic auto		-
		sa. They can show how parsers work, and they o		
	emptiness problem in case of infinite wor		11 5	5
Personal Competence Social Competence				
Autonomy				
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	90 min			
scale				
	5 5 . 1	ogram, 7 semester): Specialisation Computer Scien		ulsory
Following Curricula		ogram, 7 semester): Specialisation Computer Scien	ce. compulsory	
	Computer Science: Core Qualification: Co			
	Data Science: Core Qualification: Comput	•		
	Engineering Science: Specialisation Mech		en Flastive Corr	Jaam
		ogram, 7 semester): Specialisation Computer Science		-
	General Engineering Science (English pro	ogram, 7 semester): Specialisation Mechatronics: El	ective Compulsory	
	Comparison of Colors Inc. 1	Come Overlife and Comments		
	Computational Science and Engineering: Orientierungsstudium: Core Qualification:			

Тур Hrs/wk	Lecture
Hrs/wk	
111 <i>5/</i> WR	2
CP	4
Workload in Hours	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
	5. 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:
	 Mynni-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 expressiv
	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, pumpir
	lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars ar
	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, verification
	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	
Literature	1. Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl.
	2. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006
	3. Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010.
	4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007

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

dded Systems				
	Тур	Hrs/wk	СР	
	Lecture	3	4	
	Recitation Section (small)	1	2	
Prof. Heiko Falk				
None				
Computer Engineering				
After taking part successfully, students have	reached the following learning results			
foundations of such systems. In particular, it their specification languages (models of cor	deals with an introduction into these system mputation, hierarchical automata, specification	s (notions, commor	n characteristics) a	
hardware, embedded processors, memories, introduction into real-time operating system systems using hardware/software co-design	, energy dissipation, reconfigurable logic and ns, middleware and real-time scheduling. Fin (hardware/software partitioning, high-level tr	actuators. The council ally, the implement	urse also features ntation of embedd	
After having attended the course, students shall be able to realize simple embedded systems. The students shall realize whi relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall 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.				
Students are able to solve similar problems a	lone or in a group and to present the results a	ccordingly.		
Students are able to acquire new knowledge	from specific literature and to associate this k	nowledge with othe	er classes.	
Independent Study Time 124, Study Time in I	Lecture 56			
6				
Compulsory Bonus Form	Description			
,	and			
90 minutes, contents of course and labs				
Conoral Engineering Science (Cormon progra	7 competerly Specialization Computer Scie	nco: Elective Comp	ulcon	
			uisory	
		-		
Engineering Science: Specialisation Mechatro	nics: Elective Compulsory			
Aircraft Systems Engineering: Specialisation /	Avionic Systems: Elective Compulsory			
General Engineering Science (English program	n, 7 semester): Specialisation Computer Scier	nce: Elective Compu	ulsory	
General Engineering Science (English program	n, 7 semester): Specialisation Mechatronics: E	lective Compulsory	1	
Computational Science and Engineering: Core	e Qualification: Compulsory			
Mechatronics: Specialisation System Design:	Elective Compulsory			
Microelectronics and Microsystems: Specialisa	ation Embedded Systems: Elective Compulsor	У		
stems				
Lecture				
3				
3 4				
3 4 Independent Study Time 78, Study Time in Le	ecture 42			
3 4 Independent Study Time 78, Study Time in Le Prof. Heiko Falk	ecture 42			
3 4 Independent Study Time 78, Study Time in Le	ecture 42			
3 4 Independent Study Time 78, Study Time in Le Prof. Heiko Falk	ecture 42			
3 4 Independent Study Time 78, Study Time in Le Prof. Heiko Falk EN	ecture 42			
	None Computer Engineering After taking part successfully, students have Embedded systems can be defined as inform foundations of such systems. In particular, it their specification languages (models of conspecification of real-time applications, translat Another part covers the hardware of embe hardware, embedded processors, memories, introduction into real-time operating system systems using hardware/software co-design efficient realizations, compilers for embedded After having attended the course, students relevant parts of technological competences able to compare different models of compute which areas of embedded system design specture Students are able to solve similar problems a Students are able to acquire new knowledge Independent Study Time 124, Study Time in I 6 Compulsory Bonus Form Yes 10 % Subject theoretical practical work Written exam 90 minutes, contents of course and labs General Engineering Science (German progra General Engineering Science (German progra Computer Science: Specialisation Computer ac Computer Science: Specialisation I. Computer Electrical Engineering Science (English prograr General Engineering: Core Qualification: Ele Engine	Typ Lecture Recitation Section (small) Prof. Heiko Falk None Computer Engineering After taking part successfully, students have reached the following learning results Embedded systems can be defined as information processing systems embedded into enc foundations of such systems. In particular, it deals with an introduction into these system their specification languages (models of computation, hierarchical automata, specificati specification of real-time applications, translations between different models). Another part covers the hardware of embedded systems: Sonsors, A/D and D/A conve hardware, embedded processors, memories, energy dissipation, reconfigurable logic and introduction into real-time operating systems, middleware and real-time scheduling. Fir systems using hardware/software co-design (hardware/software partitioning, high-level tr efficient realizations, compilers for embedded processors) is covered. After having attended the course, students shall be able to realize simple embedded sy relevant parts of technological competences to use in order to obtain a functional embed able to compare different models of computations and feasible techniques for system-lev which areas of embedded system design specific risks exist. Students are able to acquire new knowledge from specific literature and to associate this k Independent Study Time 124, Study Time in Lecture 56 6 Computery Bonus Form Description Yes 10 % Subject theoretical and practical work Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7	Typ Hrs/wk Lecture 3 Recitation Section (small) 1 Prof. Heiko Falk None Computer Engineering After taking part successfully, students have reached the following learning results Embedded systems can be defined as information processing systems embedded into enclosing products. Th foundations of such systems. In particular, it deals with an introduction into these systems (notions, commor their 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 cap hardware, embedded processors, memories, energy dissipation, reconfigurable logic and actuators. The countrol transformations or system sign fordware/software co-design (nardware/software partitioning, high-level transformations of sy efficient realizations, compilers for embedded processors) is covered. After having attended the course, students shall be able to realize simple embedded systems. In pai able to compare different models of computations and feasible techniques for system-level design. They sha which areas of embedded system design specific risks exist. Students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to 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 oth	

 • 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.

Course L0806: Embedded Sy	purse L0806: Embedded Systems		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP	2		
Workload in Hours	dependent Study Time 46, Study Time in Lecture 14		
Lecturer	f. Heiko Falk		
Language			
Cycle	oSe		
Content	ee interlocking course		
Literature	See interlocking course		

Courses				
Fitle Objectoriented Programming, Algor	ithms and Data Structures (10131)	Typ Lecture	Hrs/wk 4	CP 4
Objectoriented Programming, Algor		Recitation Section (small)	1	2
Module Responsible	Prof. Rolf-Rainer Grigat			
-	None			
-	This lecture requires proficiency in the German	n language. For further requirements please re	fer to the Germar	description.
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students can explain the essentials of softw libraries and design patterns.	are design and the design of a class archited	cture with refere	nce to existing cla
	Students can describe fundamental data struc sorting and searching.	tures of discrete mathematics and assess the	complexity of imp	oortant algorithms
Skills	Students are able to			
		terns and applying class hierarchies and polym sts using version management systems and Go		
Personal Competence				
-	Students can work in teams and communicate	in forums.		
Autonomy	Students are able to solve programming tasks such as LZW data compression using SVN Repository and Google Test independe and over a period of two to three weeks.			
Workload in Hours	Independent Study Time 110, Study Time in Lo	ecture 70		
	6			
	None			
Examination	Written exam			
Examination duration and scale	60 Minutes, Content of Lecture, exercises and	material in StudIP		
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Computer Science	ce: Elective Comp	ulsory
Following Curricula	Electrical Engineering: Core Qualification: Corr	pulsory		
		, 7 semester): Specialisation Computer Science	e: Compulsory	
	Logistics and Mobility: Specialisation Engineer	ing Science: Elective Compulsory		

Course L0131: Objectoriente	d Programming, Algorithms and Data Structures		
Тур	Lecture		
Hrs/wk			
CP			
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		

ourse L0132: Objectoriented Programming, Algorithms and Data Structures		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	dependent Study Time 46, Study Time in Lecture 14	
Lecturer	f. Rolf-Rainer Grigat	
Language		
Cycle	Se	
Content	ee interlocking course	
Literature	See interlocking course	

Courses						
Title				Тур	Hrs/wk	СР
Functional Programming (L0624)				Lecture	2	2
Functional Programming (L0625)				Recitation Section (large)	2	2
Functional Programming (L0626)				Recitation Section (small)	2	2
	Prof. Sibylle Schupp					
Admission Requirements	None					
Recommended Previous	Discrete mathematio	cs at high-school	level			
Knowledge						
Educational Objectives	After taking part suc	cessfully, studer	nts have reached the	following learning results		
Professional Competence						
Knowledge	Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their abili to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and fir errors in programs. They apply the fundamental data structures, data types, and type constructors. They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies.					
Skills	Students break a natural-language description down in parts amenable to a formal specification and develop a functional program in a structured way. They assess different language constructs, make conscious selections both at specification an implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They desig and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program.					
Personal Competence						
Social Competence	Students practice poprograms orally. The			. They explain problems and solut	ions to their pee	r. They defend the
Autonomy	In programming labs, students learn under supervision (a.k.a. "Betreutes Programmieren") the mechanics of programming. In exercises, they develop solutions individually and independently, and receive feedback.					
Workload in Hours	Independent Study 1	Time 96, Study T	ime in Lecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Descrip	tion		
	Yes 15 %	Excercises				
Examination	Written exam					
Examination duration and	90 min					
scale						
Assignment for the	General Engineering	Science (Germa	n program, 7 semest	er): Specialisation Computer Science	e: Elective Comp	ulsory
Following Curricula	Computer Science: 0	Core Qualification	n: Compulsory			
	Data Science: Core (Qualification: Ele	ctive Compulsory			
	Engineering Science	: Specialisation I	Mechatronics: Elective	Compulsory		
	General Engineering	Science (English	n program, 7 semeste	r): Specialisation Computer Science	e: Elective Compu	llsory
	General Engineering	Science (English	n program, 7 semeste	r): Specialisation Mechatronics: Ele	ctive Compulsory	
	Computational Scien	co and Enginoor	ing: Specialization L (Computer Science: Elective Compu	con/	
	computational Scien	ice and Engineer	ing. specialisation i.	computer science. Elective Compu	SOLA	

Course L0624: Functional Programming			
Тур	Lecture		
Hrs/wk			
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 Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics 		
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.		

Course L0625: Functional Programming		
Тур	Recitation Section (large)	
Hrs/wk	2	
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.	

T	Desidering Conting (appell)
	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Sibylle Schupp
Language	EN
Cycle	WiSe
Content	 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.

Courses				
Title		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 have	ve reached the following learning results		
Professional Competence				
Knowledge	The students are able to			
	 explicate a specific topic in the field 	of Computer Science,		
	describe complex issues,			
	 present different views and evaluate 	e în a critical way.		
Skills	The students are able to			
	for the size is a second in the size of Course	auton Calanaa in Kasikad kina		
	familiarize in a specific topic of Com			
	realize a literature survey on the sp			
	elaborate a presentation and give a			
	 sum up the presentation in 10-15 lin answer questions in the final discussion 			
	 answer questions in the final discuss 	SIOT.		
Personal Competence				
Social Competence	The students are able to			
	 elaborate and introduce a topic for a 	a cortain audionco		
		ture of the presentation with the instructor,		
	 discuss certain aspects with the auc 			
	 as the lecturer listen and respond to 			
Autonomy	The students are able to			
	 define the task in question in an aut 	conomous way.		
	 develop the necessary knowledge, 	,		
	 use appropriate work equipment, ar 	nd		
	 guided by an instructor critically che 			
	Independent Study Time 124, Study Time	IN Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	x			
scale				
Assignment for the		gram, 7 semester): Specialisation Computer S	cience: Elective Compuls	sory
Following Curricula				
		ram, 7 semester): Specialisation Computer Se	cience: Elective Compuls	ory
	Computational Science and Engineering: C	ore Qualification: Compulsory		

Course L2362: Introductory	Course L2362: Introductory Seminar Computer Science I	
Тур	Seminar	
Hrs/wk	2	
СР	3	
Workload in Hours	pendent Study Time 62, Study Time in Lecture 28	
Lecturer	. Karl-Heinz Zimmermann	
Language	EN	
Cycle	Se/SoSe	
Content		
Literature		

Course L2361: Introductory Seminar Computer Science II		
Тур	Seminar	
Hrs/wk		
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 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				
-	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge		nd common Internet protocols in detail and cla	sify them, in order	to be able to analy
	and develop networked systems in further studies and job.			
Skills	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.			
Skiis	statents are usic to analyse common inte		unterent domains.	
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of h	nigh amount of professional knowledge and can	indonondontly loarn	and understand it
Autonomy		light amount 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	ence: 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	atronics: Elective Compulsory		
	General Engineering Science (English proc	gram, 7 semester): Specialisation Computer Scie	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	rmatics: Elective Compulsory		

Course L1098: Computer Net	tworks and Internet Security
Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Andreas Timm-Giel, DrIng. Koojana Kuladinithi, Prof. Dieter Gollmann
Language	EN
Cycle	WiSe
Content	 In this class an introduction to computer networks with focus on the Internet and its security is 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
Literature	 Internet security: Firewalls 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	purse L1099: Computer Networks 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		

Courses				
Title		Тур	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	None			
Recommended Previous	 Mathematik I + II for Engineering Students (germain 	n or english) or Analysis & Linear Alg	rebra I + II for Te	chnomathematic
Knowledge	 basic MATLAB/Python knowledge 		,	
	After taking part successfully, students have reached the	following learning results		
Professional Competence	Chudauta ana abla ta			
Knowleage	Students are able to			
	 name numerical methods for interpolation, integra 	tion, least squares problems, eigenv	value problems, r	ionlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the numerical r 			
	 explain aspects for the practical execution of nume 	rical methods with respect to comp	utational and stor	age complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical methods 	using MATLAB/Python,		
	 justify the convergence behaviour of numerical me 	thods with respect to the problem a	nd solution algori	thm,
	 select and execute a suitable solution approach for 	a given problem.		
Personal Competence				
•	Students are able to			
Social competence				
	 work together in heterogeneously composed team 	s (i.e., teams from different study pr	ograms and bac	kground knowled
	explain theoretical foundations and support each o	ther with practical aspects regarding	g the implementa	tion of algorithm
Autonomv	Students are capable			
,				
	 to assess whether the supporting theoretical and p 		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			
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Computer Science	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7 s	emester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanica	I Engineering, F	ocus Biomechai
	Compulsory General Engineering Science (German program, 7 semes	er): Specialisation Mechanical Engir	eering Focus Th	eoretical Mechai
	Engineering: Compulsory	, specialisation meenumeur Eligii		Longeneration meeting
	General Engineering Science (German program, 7 sen	ester): Specialisation Mechanical	Engineerina. Foo	us Aircraft Svst
	Engineering: Elective Compulsory		5 . 5, 00	
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engi	neering, Focus M	echatronics: Elec
	Compulsory	. 5	-	
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical I	Engineering, Foc	
		estery. specialisation mechanical i		us Energy Syste
	Elective Compulsory	estery. Specialisation mechanical i		us Energy Syste
			iry	us Energy Syste
	Elective Compulsory	cess Engineering: Elective Compulso	pry	us energy syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng	cess Engineering: Elective Compulso atics: Elective Compulsory		us Energy Syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory	tess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso		us energy syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu	tess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso		us energy syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory	tess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso		us energy syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory	cess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso Isory		us Energy Syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester	ess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso lsory r): Core Qualification: Compulsory	bry	us Energy Syste
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester	ess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso lsory r): Core Qualification: Compulsory r): Specialisation Computer Science	ry : Compulsory	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester	ess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso lsory r): Core Qualification: Compulsory r): Specialisation Computer Science	ry : Compulsory	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory	eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical	: Compulsory Engineering, F	ocus Biomechai
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester	eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical	: Compulsory Engineering, F	ocus Biomechai
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory	eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine	: Compulsory Engineering, F eering, Focus Mat	ocus Biomechai erials in Enginee
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory	eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine	: Compulsory Engineering, F eering, Focus Mat	ocus Biomechai erials in Enginee
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory	eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine	: Compulsory ⊢ Engineering, F eering, Focus Mat eering, Focus Th	ocus Biomechai erials in Enginee eoretical Mechai
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Sciences: Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory	eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine r): Specialisation Mechanical Engine	: Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso	ocus Biomechai erials in Enginee eoretical Mechai Ƴ

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I			
Тур	Lecture			
Hrs/wk				
CP				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Sabine Le Borne			
Language	EN			
Cycle	WiSe			
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 			
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 			

Course L0418: Numerical Ma	urse 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						
Fitle			Тур		Hrs/wk	СР
Computer Architecture (L0793)			Lecture		2	3
Computer Architecture (L0794)			Project-/	problem-based Learning	2	2
Computer Architecture (L1864)			Recitatio	on Section (small)	1	1
Module Responsible	Prof. Heiko Falk					
Admission Requirements	None					
Recommended Previous	Module "Computer Engineering"					
Knowledge						
Educational Objectives	After taking part successfully, st	udents have re	ached the following learni	ng results		
Professional Competence						
Knowledge	This module presents advanced	l concepts from	n the discipline of comput	ter architecture. In the	beginning, a l	broad overview ov
	various programming models	is given, both	for general-purpose cor	nputers and for specia	Il-purpose ma	achines (e.g., sigi
	processors). Next, foundational	aspects of the i	micro-architecture of proc	essors are covered. Here	e, the focus pa	articularly lies on t
	so-called pipelining and the me	thods used for	the acceleration of instru	ction execution used in	this context.	The students get
	know concepts for dynamic s	cheduling, brai	nch prediction, supersca	lar execution of machi	ne instruction	ns and for memo
	hierarchies.					
Skills	The students are able to describ	-				
	models. The students examine					
	analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memor				-	
	know parallel computer archited	tures and are a	ble to distinguish betweer	n instruction- and data-le	evel parallelis	m.
Personal Competence						
Social Competence	Students are able to solve simila	ar problems alo	ne or in a group and to pro	esent the results accordi	ngly.	
Autonomy	Students are able to acquire new	u knowlodgo fr	m chacific literature and	to accoriate this knowle	dae with othe	r classes
Autonomy	Students are able to acquire her	w knowledge no	she specific literature and		uge with othe	r classes.
Workload in Hours	Independent Study Time 110, S	tudy Time in Le	cture 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
			and			
	practical	work				
Examination	Written exam					
Examination duration and	90 minutes, contents of course	and 4 attestatio	ns from the PBL "Compute	er architecture"		
scale						
Assignment for the	General Engineering Science (G	erman program	, 7 semester): Specialisati	on Computer Science: E	lective Compu	ulsory
Following Curricula	Computer Science: Specialisatio	n Computer an	d Software Engineering: E	lective Compulsory		
	Computer Science: Specialisatio	n I. Computer a	nd Software Engineering:	Elective Compulsory		
	Aircraft Systems Engineering: C	ore Qualificatio	n: Elective Compulsory			
	Aircraft Systems Engineering: S	pecialisation Av	ionic Systems: Elective Co	ompulsory		
	General Engineering Science (Er	nglish program,	7 semester): Specialisatio	on Computer Science: El	ective Compu	lsory
	Computational Science and Eng	ineering: Specia	alisation I. Computer Scier	nce: Elective Compulsory	,	

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		Тур	Hrs/wk	СР			
Computability and Complexity The		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	a Theory, Logic, and Formal Language Theory.					
Knowledge							
Educational Objectives	After taking part successfully, students	have reached the following learning results					
Professional Competence							
Knowledge	The students known the important machine models of computability, the class of partial recursive functions, universe 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 system 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 prob	lems alone or in a group and to present the result	s accordingly.				
Autonomy	Students are able to acquire new knowl	edge from newer literature and to associate the a	acquired knowledge w	ith other classes.			
Workload in Hours	Independent Study Time 124, Study Tin	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 g	program, 7 semester): Specialisation Computer Sc	ience: Elective Comp	ulsory			
Following Curricula	Computer Science: Core Qualification: C	Compulsory		,			
	Data Science: Core Qualification: Elective Compulsory						
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory						
	Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory						
	Technomathematics: Specialisation II. Ir						

Course 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	

Module M0971: Opera	iting 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		was and data structures			
Knowledge	Object-oriented programming, algorith	ims, and data structures			
	Procedural programming Evenerics in using tools related to an	ersting systems such as editors, linkars, sometil			
		erating systems such as editors, linkers, compile	ers		
	Experience in using C-libraries				
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	Students explain the main abstractions proc	ess, virtual memory, deadlock, lifelock, and fil	e of operations sy	ystems, describe th	
	process states and their transitions, and paraphrase the architectural variants of operating systems. They give ex				
	existing operating systems and explain their	architectures. The participants of the course wr	ite concurrent pro	grams using thread	
	conditional variables and semaphores. Stude	nts can describe the variants of realizing a file s	ystem. Students e	explain at least thre	
	different scheduling algorithms.				
Skille	Students are able to use the POSIX libraries t	for concurrent programming in a correct and eff	icient way They a	are able to judge the	
SKIIS	efficiency of a scheduling algorithm for a give	1 5 5	iciciic way. They c	are usic to judge the	
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in I	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, 7 semester): Specialisation Computer Science	e: Elective Comp	ulsory	
Following Curricula	Computer Science: Specialisation I. Computer	r and Software Engineering: Elective Compulsor	у		
	General Engineering Science (English program	n, 7 semester): Specialisation Computer Science	e: Elective Compu	llsory	
	Computational Science and Engineering: Spe	cialisation I. Computer Science: Elective Compu	lsory		
	Technomathematics: Specialisation II. Inform	atics: Elective Compulsory			

Course L1153: Operating Sys	stems
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	stems			
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						
ſitle			Тур	Hrs/wk	СР	
Software Engineering (L0627)			Lecture	2	3	
Software Engineering (L0628)			Recitation Section (small)	2	3	
Module Responsible	Prof. Sibylle Schupp					
Admission Requirements	None					
Recommended Previous	• Automata theory an	formal languages				
Knowledge	Automata theory an Brocodural program	ning or Functional program	mina			
		amming, algorithms, and				
	 Object-offented prog 	annining, algorithnis, and				
Educational Objectives	After taking part successfu	y, students have reached	the following learning results			
Professional Competence						
Knowledge	Students explain the pha	ses of the software life	cycle, describe the fundamental ter	minology and co	oncepts of softwa	
	engineering, and paraphra	e the principles of structur	ed software development. They give ex	amples of softwa	re-engineering tas	
	of existing large-scale systems. They write test cases for different test strategies and devise specifications or models usin					
different notations, and critique both. They explain simple design patterns and the major activities					quirements analys	
	maintenance, and project planning.					
Skills	For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. The					
34///3	choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and fin					
errors at different levels. They apply and modify non-executable artifacts. They integrate components based						
	specifications.					
	specificationsi					
Personal Competence						
Social Competence	Students practice peer pro	ramming. They explain pr	oblems and solutions to their peer. They	/ communicate in	English.	
Autonomy	Using on-line guizzes and	accompanying material fo	self study, students can assess their	level of knowled	ge continuously a	
Autonomy			, they receive additional feedback.		ge continuously a	
			,,			
Workload in Hours	Independent Study Time 1	4, Study Time in Lecture 5	6			
	6					
Course achievement			scription			
		rcises				
	Written exam					
	90 min					
scale						
-			nester): Specialisation Computer Scienc	e: Elective Comp	ulsory	
Following Curricula	Computer Science: Core Qu					
			ester): Specialisation Computer Science		lsory	
	Computational Science and	Engineering: Specialisatio	n I. Computer Science: Elective Compul	sory		

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	ineering
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

Courses							
Title	Тур		Hrs/wk	СР			
Lab Cyber-Physical Systems (L174)		d Learning	4	6			
Module Responsible	Prof. Heiko Falk						
Admission Requirements							
Recommended Previous	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 environme	ent, via sen	sors, A/D and	D/A converters, a			
	actors. Due to their particular application areas, highly specialized sensors, processo	rs and actor	rs are commor	n. Accordingly, the			
	is a large variety of different specification approaches for CPS - in contrast to classica	l software e	ngineering ap	proaches.			
	Based on practical experiments using robot kits and computers, the basics of specif	ication and	modelling of	CRE are taught T			
	lab introduces into the area (basic notions, characteristical properties) and their spe-		-	-			
	hierarchical automata, data flow models, petri nets, imperative approaches). Since C			-			
	experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification tool (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and						
	actors.						
Skills	After successful attendance of the lab, students are able to develop simple CPS. They	understand	the interdepe	endencies betwee			
	CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D converte						
	digital processors, D/A converters and actors. The lab enables students to compa	are modellin	ng approache	s, to evaluate th			
	advantages and limitations, and to decide which technique to use for a concrete task	. They will	be able to app	oly these techniqu			
	to practical problems. They obtain first experiences in hardware-related software de	evelopment,	, in industry-re	elevant specificat			
	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 res	ults accordi	ingly.				
Autonomv	Students are able to acquire new knowledge from specific literature and to associate	this knowle	dae with other	r classes.			
	Independent Study Time 124, Study Time in Lecture 56						
Credit points	6						
Course achievement	None						
Examination							
Examination duration and	Execution and documentation of all lab experiments						
scale							
Assignment for the			lective Compu	llsory			
Following Curricula	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective C						
	Computer Science: Specialisation Computer and Software Engineering: Elective Comp General Engineering Science (English program, 7 semester): Specialisation Computer		active Comput	sory			
	Computational Science and Engineering: Specialisation II. Mathematics & Engineering			-			
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory	Science: El	ecuve compu	1501 ý			
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory						
	Mechatronics: Technical Complementary Course: Elective Compulsory						

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

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	<u> </u>							
Title				Тур		Hrs/wk	СР	
Embodiment Design and 3D-CAD (L0268)				Lecture		2	1	
Mechanical Design Project I (L0695))			Project-/problem-based Le	earning	3	2	
Mechanical Design Project II (L0592				Project-/problem-based Le		3	2	
Team Project Design Methodology (L0267)			Project-/problem-based Le	earning	2	1	
Module Responsible	Prof. Diete	r Krause						
Admission Requirements	None							
Recommended Previous	- 5.00		of Machanical Engineerin	- Design				
Knowledge			of Mechanical Engineering	g Design				
	 Mec 		of Motoriala Caionaa					
			of Materials Science					
	 Proc 	luction Eng	Jineering					
Educational Objectives	After takin	g part succ	essfully, students have re	ached the following learning results				
Professional Competence								
Knowledge	After passi	ng the mo	dule, students are able to:					
-								
				parts e.g. considering load situation, mate	erials an	d manufacturi	ng requirement	
			s of 3D CAD,					
	 expl 	ain basics	methods of engineering d	esigning.				
Skills	After passi	na the mo	dule, students are able to:					
	 independently create sketches, technical drawings and documentations e.g. using 3D CAD, 							
	 desi 	gn compor	nents based on design gui	delines autonomously,				
			culate) used components					
	• use	methods to	o design and solve engine	ering design tasks systamtically and solut	ion-orier	nted,		
	 appl 	y creativit	y techniques in teams.					
Personal Competence								
-	Aftor nacci	na the mo	dule students are able to					
social competence	After passing the module, students are able to:							
	 develop and evaluate solutions in groups including making and documenting decisions, 							
	• mod	lerate the	use of scientific methods,					
	 pres 	ent and di	scuss solutions and techn	ical drawings within groups,				
	 refle 	ect the owr	results in the work group	os of the course.				
Autonomy	Students a	re able						
	e to c	stimato th	oir loval of knowladga usi	ng activating methods within the lectures	(o a wi	th clickors)		
			eering design tasks system		(e.g. wi	un clickers),		
	• 105	olve eligili	eening design tasks system	nationly.				
Workload in Hours	Independe	nt Study Ti	me 40, Study Time in Lec	ture 140				
Credit points	6							
Course achievement			Form	Description				
	Yes	None	Written elaboration	Konstruktionsprojekt 1				
	Yes	None	Written elaboration	Konstruktionsprojekt 2				
	Yes	None	Written elaboration	3D-CAD-Praktikum				
	Yes	None	Written elaboration	Teamprojekt Konstruktionsmethodik				
Examination	Written ex	am						
Examination duration and	180							
scale								
Assignment for the	General En	gineering	Science (German program	n, 7 semester): Specialisation Mechanical E	ngineer	ing: Compulso	ory	
Following Curricula	General En	gineering	Science (German program	n, 7 semester): Specialisation Biomedical E	ngineer	ing: Compulso	ory	
	General En	gineering	Science (German program	n, 7 semester): Specialisation Energy and E	Invirom	ental Enginee	ring: Compulsor	
	Digital Mechanical Engineering: Core Qualification: Compulsory							
	Energy and	d Environm	ental Engineering: Core C	ualification: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory							
	General En	gineering	Science (English program	7 semester): Specialisation Energy and E	nvirome	ntal Engineeri	ing: Compulsory	

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

Tvn	Lecture
Hrs/wk	
	2
СР	
	Independent Study Time 2, Study Time in Lecture 28
	Prof. Dieter Krause
Language	
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, aktuel
	Auflage.
	 Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage.
	 Dubbel, Taschenbuch f ür den Maschinenbau; Grote, KH., Feldhusen, I.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelse
	aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuel
	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	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 D	esign 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.

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

C				
Courses				
Title	1 (1 2 2 2 5)	Тур	Hrs/wk	СР
Fundamentals of Materials Science I (L1085) Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)		Lecture Lecture	2	2 2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible			_	
Admission Requirements				
	Highschool-level physics, chemistry und mathematics			
Knowledge	ngrischool-level physics, chemistry und matiematics			
Kilowieuge				
Educational Objectives	After taking part successfully, students have reached the follow	ving loarning rosults		
Professional Competence	Arter taking part successiony, students have reached the follow	ving learning results		
-	The students have acquired a fundamental knowledge on r	motals coramics and	nolymore and can doce	riba this knowla
Knowledge	comprehensively. Fundamental knowledge here means specific			
	phase transformations, corrosion and mechanical properties. Th			
	for materials and can identify relevant approaches for cha			
	phenomena back to the underlying physical and chemical laws		roperties. They are able	
		ornatarer		
Skills	The students are able to trace materials phenomena back t	the underlying phy	sical and chemical laws	of nature. Mate
	phenomena here refers to mechanical properties such as stree	ngth, ductility, and st	iffness, chemical propertie	es such as corro
	resistance, and to phase transformations such as solidificatio	n, precipitation, or m	nelting. The students can	explain the rela
	between processing conditions and the materials microstructu	ure, and they can acc	count for the impact of m	icrostructure on
	material's behavior.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
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): S	pecialisation Mechanio	cal Engineering: Compulso	iry
Following Curricula	General Engineering Science (German program, 7 semester): S	pecialisation Biomedic	cal Engineering: Compulso	ry
	General Engineering Science (German program, 7 semester): S	pecialisation Energy a	nd Enviromental Engineer	ing: Compulsory
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Ar	chitecture: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Ar	chitecture: Compulsory	
	Data Science: Specialisation Materials Science: Compulsory			
	Digital Mechanical Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification: Con			
	General Engineering Science (English program, 7 semester): Sp		-	• • •
	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			У
	General Engineering Science (English program, 7 semester): Sp		nitecture: 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	achive Company Internet		

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 P. Haasen: Physikalische Metallkunde. Springer 1994

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 (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	Ту	p	Hrs/wk	СР
Fluid Mechanics (L0454)		cture	3	4
Fluid Mechanics (L0455)	Rei	citation Section (large)	2	2
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics, engineering mechan	ics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following le	earning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to explain the Students can scientifically outline the rationale of flow physics usin performance analysis and the prediciton of fluid engineering devices	ng mathematical models and		
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lectur enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop solution	on strategies.		
Autonomy	The students are able to develop solution strategies for complex pro	blems self-consistent and crt	ically analyse re	sults.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Engineeri	ng: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester): Specia			
-	General Engineering Science (German program, 7 semester): Specia			
	General Engineering Science (English program, 7 semester): Special	isation Mechanical Engineerir	ng: Compulsory	
	General Engineering Science (English program, 7 semester): Special	isation Naval Architecture: Co	ompulsory	
	General Engineering Science (English program, 7 semester): Special	isation Biomedical Engineerin	ig: Compulsory	
	Computational Science and Engineering: Specialisation Engineering	Sciences: Elective Compulsor	У	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: Elective	Compulsory		

ourse L0454: Fluid Mechan	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/EN
Cycle	SoSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	 the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg.

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

Courses					
Title		Тур	Hrs/wk	СР	
	al Mechanics, Numerical Mechanics) (L1137) al Mechanics, Numerical Mechanics) (L1138)	Lecture Recitation Section (small)	3 2	3 2	
	al Mechanics, Numerical Mechanics) (L1138)	Recitation Section (small)	1	1	
Module Responsible			_	_	
Admission Requirements					
	Mathematics I-III and Mechanics I-III				
Knowledge					
Educational Objectives	After taking part successfully, students have reach	ed the following learning results			
Professional Competence	, the raining part succession, scale here reach				
-	The students can				
hitemedge					
	 describe the axiomatic procedure used in m 	echanical contexts;			
	explain important steps in model design;				
	 present technical knowledge. 				
Skills	The students can				
	explain the important elements of mathematical elements of mathematical elements of mathematical elements and the second elements of the second elements elements of the second elements	atical / mechanical analysis and model for	mation, and apply	, it to the context	
	their own problems;	· · · · · · · · · · · · · · · · · · ·			
	 apply basic methods to engineering problem 	ns;			
	estimate the reach and boundaries of the m	ethods and extend them to be applicable to	o wider problem s	sets.	
Personal Competence					
Social Competence	The students can work in groups and support each	other to overcome difficulties.			
Autonomy	Students are capable of determining their own stre	angths and weaknesses and to organize the	ir time and learn	ing based on those	
Autonomy	Students are capable of determining their own stre		in time and learn	ing based on those	
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	120 min				
scale					
Assignment for the	General Engineering Science (German program, 7				
				ory	
Following Curricula	General Engineering Science (German program 7		·o· Compulsory		
Following Curricula		semester): Specialisation Naval Architectur	e. compaisory		
Following Curricula	Energy Systems: Technical Complementary Course	e Core Studies: Elective Compulsory			
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine	eering: Compulso	ry	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s	e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture	eering: Compulso e: Compulsory	-	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s	e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine	eering: Compulso e: Compulsory	-	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu	e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine	eering: Compulso e: Compulsory	-	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory	e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine ulsory	eering: Compulso e: Compulsory	-	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Comput Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory	eering: Compulso e: Compulsory	-	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory	eering: Compulso e: Compulsory eering: Compulsor	-	
Following Curricula	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory	eering: Compulso e: Compulsory eering: Compulsor	-	
	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine alsory g Science: Elective Compulsory nplementary Course Core Studies: Elective	eering: Compulso e: Compulsory eering: Compulsor	-	
Course L1137: Mechanics IV	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine alsory g Science: Elective Compulsory nplementary Course Core Studies: Elective	eering: Compulso e: Compulsory eering: Compulsor	-	
	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compute Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine alsory g Science: Elective Compulsory nplementary Course Core Studies: Elective	eering: Compulso e: Compulsory eering: Compulsor	-	
Course L1137: Mechanics IV Typ	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture 3	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine alsory g Science: Elective Compulsory nplementary Course Core Studies: Elective	eering: Compulso e: Compulsory eering: Compulsor	-	
Course L1137: Mechanics IV Typ Hrs/wk CP	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compute Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture 3 3	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective	eering: Compulso e: Compulsory eering: Compulsor	-	
Course L1137: Mechanics IV Typ Hrs/wk	Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compute Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture 3 3	e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective	eering: Compulso e: Compulsory eering: Compulsor	-	

Language	DE
Cycle	SoSe
Content	
	 Elements of vibration theory Vibration of Multi-degree of freedom systems Analytical Mechanics 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	(Oscillations, Analytical Mechanics, Numerical Mechanics)
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	(Oscillations, Analytical Mechanics, Numerical Mechanics)
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
l anguage	DE

Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses							
				Turn	11		CD.
Title Practical Course: Measurement an	d Control Systems (1111)	0)		Typ Practical Course	Hrs/v 2	VK	CP 2
Measurement Technology for Mech	-			Lecture	2		3
Measurement Technology for Mech				Recitation Section (la			1
Module Responsible				· · ·	5.		
Admission Requirements							
Recommended Previous		hysics, chemistry	v and electrical eng	ineering			
Knowledge	Basie knowledge of p		y and cleethear eng	lineering			
Educational Objectives	After taking part succ	cessfully, student	ts have reached the	following learning results			
Professional Competence	51	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
				ntals of the Measurement T d Systems).	echnology (Quantit	ies and	Units, Uncertai
	They can outline the Temperature, mechan			ds for different kinds of quancy).	antities to be maes	ured (E	lectrical Quanti
	They can describe im	portant methods	s of chemical Analys	is (Gas Sensors, Spectrosco	ppy, Gas Chromatog	raphy)	
Skills	Students can select s	uitable measurir	ng methods to giver	problems and can use refe	ring measurement	devices	in practice.
	The students are able	e to orally explai	in issues in the sub	ject area of measurement t	echnology and solu	ition app	proaches as we
	place the issues into	the right context	t and application are	ea.			
Personal Competence							
	Students can arrive a	t work recults in	around and docum	ent them in a common repo	rt.		
				asurement technologies.			
Workload in Hours	Independent Study Ti			asurement technologies.			
Workload in Hours Credit points	Independent Study Ti	ime 110, Study T	Fime in Lecture 70				
Workload in Hours	Independent Study Ti 6 Compulsory Bonus	ime 110, Study T Form	Fime in Lecture 70 Descri				
Workload in Hours Credit points	Independent Study Ti	ime 110, Study T Form Subject theo	Fime in Lecture 70 Descri oretical and				
Workload in Hours Credit points Course achievement	Independent Study Ti 6 Compulsory Bonus Yes None	ime 110, Study T Form Subject theo practical work	Fime in Lecture 70 Descri oretical and				
Workload in Hours Credit points Course achievement Examination	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar	ime 110, Study T Form Subject theo practical work	Fime in Lecture 70 Descri oretical and				
Workload in Hours Credit points Course achievement Examination Examination duration and	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar	ime 110, Study T Form Subject theo practical work	Fime in Lecture 70 Descri oretical and				
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes	me 110, Study T Form Subject theo practical work	Fime in Lecture 70 Descri oretical and	ption	cal Engineering: Co	mpulsor	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S	Form Subject thee practical work nd practical work Science (German	Fime in Lecture 70 Descri oretical and n program, 7 semes	ption ter): Specialisation Mechani			
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S	Form Subject thee practical work nd practical work Science (German Science (German	Fime in Lecture 70 Descri oretical and n program, 7 semes n program, 7 semes	ption ter): Specialisation Mechani ter): Specialisation Biomedi	cal Engineering: Co	mpulsor	y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S	Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar	Time in Lecture 70 Description	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a	cal Engineering: Co	mpulsor	y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En	Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar gineering: Core	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Comp	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory	cal Engineering: Co	mpulsor	y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En Energy and Environm	Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar gineering: Core tental Engineerin	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Comp ng: Core Qualificatio	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory	cal Engineering: Co	mpulsor	у
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En Energy and Environm	Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar gineering: Core tental Engineerin Specialisation M	Time in Lecture 70 Description oretical and oretical and oretical and oregram, 7 semes or program, 7 semes or program, 7 semes Qualification: Comp og: Core Qualificatio lechatronics: Comp	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory Jlsory	cal Engineering: Co	mpulsor	y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science:	Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar science (Germar spienering: Core tental Engineerin Specialisation M	Time in Lecture 70 Descri oretical and and and and and and and and	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory Jlsory	cal Engineering: Co	mpulsor	y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science:	Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar Science (Germar spienering: Core tental Engineerin Specialisation M Specialisation B	Time in Lecture 70 Descri oretical and and and and and and and and	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory ng: Elective Compulsory	cal Engineering: Co and Enviromental Er	mpulsor	y ng: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S	Form Subject thee practical work and practical work digractical work Science (German Science (German Science (German Specialisation M Specialisation M Specialisation Bi Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu g: Core Qualificatio lechatronics: Compu lechanical Engineer iomedical Engineer program, 7 semest	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory	cal Engineering: Co and Enviromental Er nd Enviromental En	mpulsor ngineerin gineerin	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S	Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Science (Germar specialisation M Specialisation M Specialisation B Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu g: Core Qualification lechatronics: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semest	ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory ng: Elective Compulsory er): Specialisation Energy a	cal Engineering: Co and Enviromental Er nd Enviromental En ral Engineering: Cor	mpulsor ngineerin gineerin npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S	Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu g: Core Qualification lechatronics: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semest program, 7 semest	etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic	cal Engineering: Co and Enviromental En nd Enviromental En ral Engineering: Cor al Engineering: Con	mpulsor ngineerin gineerin npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S General Engineering S	Form Subject thee practical work and practical work digractical work Science (German Science (German Science (German Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lecharical Engineer iomedical Engineer program, 7 semest program, 7 semest program, 7 semest program, 7 semest	etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Compulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Biomedic	cal Engineering: Co and Enviromental En ad Enviromental En cal Engineering: Cor al Engineering: Con nics: Compulsory	mpulsor ngineerin npulsory npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S General Engineering S General Engineering S General Engineering S	Form Subject thee practical work nd practical work nd practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation Bi Science (English Science (English Science (English Science (English Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lecharical Engineer iomedical Engineer program, 7 semest program, 7 semest program, 7 semest program, 7 semest program, 7 semest program, 7 semest	ettion ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Compulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Biomedic er): Specialisation Mechatro	cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor	mpulsor ngineerin npulsory npulsory npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S Genera	Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English Science (English Science (English Science (English Science (English Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lecharical Engineer iomedical Engineer program, 7 semest program, 7 semest	etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic	cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor al Engineering: Elec	mpulsor ngineerin npulsory npulsory npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S Genera	Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation M Specialisation M Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semest	etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic	cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor al Engineering: Elec	mpulsor ngineerin npulsory npulsory npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S Genera	Form Subject thee practical work and practical work and practical work science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semes	etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic	cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor al Engineering: Elec	mpulsor ngineerin npulsory npulsory npulsory	y ng: Compulsory g: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S Genera	Form Subject thee practical work and practical work and practical work science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English) Science (English Science (English) Science (English)	Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semes	etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic	cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Cor al Engineering: Cor al Engineering: Cor al Engineering: Elec e Compulsory	mpulsor ngineerin npulsory npulsory npulsory ctive Cor	y ng: Compulsory g: Compulsory , npulsory

	Practical Course
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Thorsten Kern
Language	
2	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 w 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 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

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	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

Focus Biomechanics

Modulo MOEOZi Advo	iomechanics get in addition to their core eng ables them to understand operational planni	ng as well as research and development in	this highly inter	disciplinary area
Module M0597: Adva	nced Mechanical Engineering De	sign		
Courses				
Γitle		Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (L0264)	Lecture	2	2
Advanced Mechanical Engineering		Recitation Section (large)	2	1
Advanced Mechanical Engineering Advanced Mechanical Engineering		Lecture Recitation Section (large)	2	2 1
Module Responsible			_	_
Admission Requirements				
Recommended Previous	•			
Knowledge	 Fundamentals of Mechanical Engineering Mechanics 	g Design		
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objections				
Professional Competence	After taking part successfully, students have re	ached the following learning results		
-	After passing the module, students are able to:			
hitemetage				
		functions of machine elements and of basic ele		
	 explain requirements, selection criteria, indicate the background of dimensioning 	application scenarios and practical examples o calculations	or complex machi	ne elements,
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of	covered machine elements,		
		e to new requirements and tasks (problem sol	ving skills),	
	recognize the content of technical drawin	ngs and schematic sketches,		
	evaluate complex designs, technically.			
Personal Competence				
Social Competence		formation in the lecture supported by activatin	a methods	
			g methodol	
Autonomy	 Students are able to independently deep 	en their acquired knowledge in exercises.		
	• Students are able to acquire additional	knowledge and to recapitulate poorly unders	tood content e.g	. by using the vid
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lect	ture 112		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the		-		
	General Engineering Science (German progr	am, 7 semester): Specialisation Mechanica		-
Following Curricula	Compulson		l Engineering, F	-
Following Curricula	Compulsory General Engineering Science (German progra	am 7 semester): Specialisation Mechanical (ocus Biomechani
Following Curricula	Compulsory General Engineering Science (German progra Compulsory	am, 7 semester): Specialisation Mechanical I		ocus Biomechani
Following Curricula	General Engineering Science (German progra		Engineering, Foc	ocus Biomechani us Energy Systen
Following Curricula	General Engineering Science (German progra Compulsory		Engineering, Foc	ocus Biomechani us Energy Systen
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog	am, 7 semester): Specialisation Mechanical	Engineering, Foc Engineering, Foc	ocus Biomechani us Energy Systen us Aircraft Syster
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanic	Engineering, Foc Engineering, Foc al Engineering,	ocus Biomechani us Energy System us Aircraft System Focus Materials
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanic	Engineering, Foc Engineering, Foc al Engineering,	ocus Biomechani us Energy System us Aircraft System Focus Materials
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanic ram, 7 semester): Specialisation Mechanica	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, I	ocus Biomechani us Energy System us Aircraft System Focus Materials Focus Mechatroni
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanic ram, 7 semester): Specialisation Mechanica	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, I	ocus Biomechani us Energy System us Aircraft System Focus Materials Focus Mechatroni
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program	am, 7 semester): Specialisation Mechanical rram, 7 semester): Specialisation Mechanic ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi	Engineering, Foc Engineering, Foc al Engineering, I Engineering, f ineering, Focus P	us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Engineering: Compulsory	am, 7 semester): Specialisation Mechanical rram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi	Engineering, Foc Engineering, Foc al Engineering, I Engineering, f ineering, Focus P	us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German program Engineering: Compulsory Energy Systems: Technical Complementary Com	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engir urse Core Studies: Elective Compulsory	Engineering, Foc Engineering, Foc al Engineering, I Engineering, f ineering, Focus P	us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German program Engineering: Compulsory Energy Systems: Technical Complementary Com Engineering Science: Specialisation Mechanical	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi urse Core Studies: Elective Compulsory Engineering: Compulsory	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, Focus P neering, Focus Th	ocus Biomechani us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme Reoretical Mechani
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German program Engineering: Compulsory Energy Systems: Technical Complementary Com	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi urse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, Focus P Ineering, Focus Th Deering: Compulso	ry
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English program,	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi urse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, Focus P Ineering, Focus Th Deering: Compulso	ry
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program) Compulsory General Engineering Science (English program)	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi arse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, Focus P neering, Focus Th eering: Compulso I Engineering, F	vocus Biomechani us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme reoretical Mechani ry ocus Biomechani
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi arse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc	iocus Biomechani us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme reoretical Mechani ry iocus Biomechani us Energy System
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English progra General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi arse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, I I Engineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc	iocus Biomechani us Energy System us Aircraft System Focus Materials Focus Mechatroni Product Developme reoretical Mechani ry iocus Biomechani us Energy System
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English progra General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi rurse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engine m, 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, F ineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc Engineering, Foc	iocus Biomechani us Energy System tus Aircraft System Focus Materials Focus Mechatroni Product Developme teoretical Mechani ry iocus Biomechani us Energy System us Aircraft System
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English progra General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi rurse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engine m, 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, F ineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc Engineering, Foc	iocus Biomechani us Energy System tus Aircraft System Focus Materials Focus Mechatroni Product Developme teoretical Mechani ry iocus Biomechani us Energy System us Aircraft System
Following Curricula	General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory Energy Systems: Technical Complementary Cou Engineering Science: Specialisation Mechanical General Engineering Science (English progra General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra Engineering: Compulsory General Engineering Science (English progra	am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi n, 7 semester): Specialisation Mechanical Engi rurse Core Studies: Elective Compulsory Engineering: Compulsory 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine am, 7 semester): Specialisation Mechanical Engine m, 7 semester): Specialisation Mechanical Engine	Engineering, Foc Engineering, Foc al Engineering, Foc I Engineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc Engineering, Foc Engineering, Foc	iocus Biomechani us Energy System tus Aircraft System Focus Materials Focus Mechatroni Product Developme teoretical Mechani us Energy System us Aircraft System terials in Engineeri

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

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 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 Lo265: Advanced W=rickl Engineering Design II

 Course Lo265: Advanced W=rickl Engineering Design II

 Recitation Section (large)

 Recitation Section (large)

 Image: Profestion Section (large)

 Point Section Section (large)

 Image: Profestion Section Secti

Hrs/wk 2 Or Valadia Muss Independent Study Time 32, Study Time in Lecture 28 Vorkhadia Muss Independent Study Time 32, Study Time in Lecture 28 Lecture Prof. Dieter Krause, Prof. Otto von Estorff Language DE Cycle Wise Content Advanced Mechanical Engineering Design 1 & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Cutches & torakes Belt & chain drives Exercise Elements of fluidics Ecercise Calculation methods of the following machine elements: Linear rolling bearings Teamer of fluidics Exercise Elements of fluidics Exercise Belt & chain drives Gear drives Belt & chain drives Gear drives Studing bearings Axes & shafts Outches & torakes Belt & chain drives Gear drives Studing bearings Calculation methods of the following machine elements: Calculation methods of the following machine elements: Calculation methods of the following machine elements: Calculation for hydrostatic systems (fluidics) Calculation methods of the following machine elements: Schort Hydrostatic systems (fluidics) Calculation for hydrostatic systems (fluidics) Calculation for hydrostatic systems (fluidics)	Тур	Lecture
Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Piof. Dieter Krause, Prof. Otto von Estorff Language DE Cycte WiSe Context Advanced Mechanical Engineering Design 1 & II Lecture 	Hrs/wk	2
Lecturer Prof. Dieter Krause, Prof. Otto von Estorff Language DE Cyctet Wise Content Advanced Mechanical Engineering Design 1 & II Lecture • Fundamentals of the following machine elements: • Unear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Elements of fluidics Exercise • Clackulation methods of the following machine elements: • Unear rolling bearings • Crank drives • Siding bearings • Calculation methods of the following machine elements: • Unear rolling bearings • Calculation methods of the following machine elements: • Unear rolling bearings • Axes & shafts • Calculation methods of the following machine elements: • Unear rolling bearings • Axes & shafts • Calculation methods of the following machine elements: • Unear rolling bearings • Axes & shafts • Calculation for the following machine elements: • Unear rolling bearings • Axes & shafts • Calculation for the following machine elements: • Unear rolling bearings • Calculations of hydrostatic systems (fluidics) Literature • Calculation 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. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Pahl, G.; Betz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Pahl, G.; Betz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle	CP	2
Language DE Cycle WiSe Advanced Mechanical Engineering Design I & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Clutches & brakes Belt & chain drives Gear drives Grank drives Gear drives Silding bearings Elements of fluidics Exercise Clutches & brakes Belt & chain drives Glad bearings Elements of fluidics Exercise Clutches & brakes Belt & chain drives Glad bearings Axes & shafts Clutches & brakes Belt & chain drives Glad bearings Axes & shafts Clutches & brakes Belt & chain drives Gear drives Glad bearings Claculations 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. Maschinenelemente, Band I-III; Nemann, G., Springer-Verlag, aktuelle Auflage. Konstruktionselemente; Scheit, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelementer - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. 	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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 Elements of fluidics Exercise Claculation methods of the following machine elements: Linear rolling bearings Clack brakes Bilding bearings Elements of fluidics Exercise Calculation methods of the following machine elements: Linear rolling bearings Elements of fluidics Exercise Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Belt & chain drives Gear drives Gear drives Sliding bearings Clutches & brakes Belt & chain drives Gear drives Elerkeris Cluclations 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. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Einführung in die DUN-Normer; Kichen, M., Teubner-Verlag, Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Kaschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestattung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-V	Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Content Advanced Mechanical Engineering Design 1 & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Clutches & brakes Beit & chain drives Gear drives Elements of fluidics Exercise Clutches & brakes Stilling bearings Elements of fluidics Exercise Clutches & brakes Beit & chain drives Clutches & brakes Stilling bearings Elements of fluidics Exercise Clutches & brakes Beit & chain drives Clutches & brakes Beit & chain drives Gear drives Beit & chain drives Gear drives Beit & chain drives Gear drives Silding bearings Crank gears Crank gears Silding 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. Maschinenelemente, Steinhilper, W., Röper, R., Springer-Verlag, aktuelle Auflage. Einführung in die DIN-Normer, Nichin, M., Teubner-Verlag, Aktuelle Auflage. Maschinenelemente 1-Gestatung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.	Language	DE
Content Advanced Mechanical Engineering Design I & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Clutches & brakes Beit & chain drives Gear drives Epicyclic gears Crank drives Sliding bearings Siding bearings Elements of fluidics Exercise Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Beit & chain drives Gear drives Sliding bearings Axes & shafts Clutches & brakes Beit & chain drives Clutches & brakes Beit & chain drives Gear drives Gear drives Beit & chain drives Gear drives Beit & chain drives Gear drives Sliding bearings Calculations of hydrostatic systems (fluidics) Literature Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Veriag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Veriag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Veriag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Veriag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Veriag, aktuele Auflage.	Cycle	WiSe
 Fundamentals of the following machine elements: Unear rolling bearings Axes & shafts Seals Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Crank drives Sliding bearings Elements of fluidics Elements of fluidics Exercise Calculation methods of the following machine elements: Unear rolling bearings Exercise Calculation methods of the following machine elements: Unear rolling bearings Axes & shafts Clutches & brakes Gear drives Crank gears Crank gears Sliding bearings Exercise Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.): Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Stein MJ, Teubner-Verlag, Konstruktionselemente; Steinhilper, W., Röper, A., Springer Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlicht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlicht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlicht, B., Pearson Verlag, aktuelle Auflage. 	Content	Advanced Mechanical Engineering Design I & II
 Linear rolling bearings Axes & shafts Seals Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Crank drives Sliding bearings Elements of fluidics Exercise Clutches & brakes Belt & chain drives Sliding bearings Elements of fluidics Exercise Clutches & brakes Belt & chain drives Clutches & brakes Belt & chain drives Gear drives Gear drives Clutches & brakes Belt & chain drives Clutches & brakes Belt & chain drives Clutches & brakes Belt & chain drives Claculation 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. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag, aktuelle Auflage. Maschinenelemente, Fahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. 		Lecture
 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 Elements of fluidics Exercise Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Belt & chain drives Gear drives Gear drives Gear drives Gear drives 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. Maschinenel- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenel 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelement - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. 		Fundamentals of the following machine elements:
 Seals Seals Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Crank drives Silding bearings Elements of fluidics Exercise Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Belt & chain drives Gear drives Belt & chain drives Gear drives Epicyclic gears Crank gears Crank gears Cluches & brakes Belt & chain drives Gear drives Epicyclic gears Crank gears Silding bearings Calculations of hydrostatic systems (fluidics) Literature Uubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.		Linear rolling bearings
Litterature • Clutches & brakes • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Silding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Belt & chain drives • Gear drives • Epicyclic gears • Crank gears • Silding 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. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente; Steinhilper, W., Röper, R., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente; Steinhilper, W., Röper, R., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente; Steinhilper, W., Röper, R., Springer-Verlag, aktuelle Auflage.		• Axes & shafts
Belt & chain drives Gear drives Gear drives Gear drives Gear drives Dicyclic 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 d		• Seals
 Gear drives Epicyclic gears Crank drives Silding bearings Elements of fluidics Exercise Calculation methods of the following machine elements: Linear rolling bearings Axes & shafts Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Clutches & brakes Belt & chain drives Gear drives Epicyclic gears Silding bearings Calculations of hydrostatic systems (fluidics) Literature Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-II; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.		Clutches & brakes
 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 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. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinenelemente, Reid, M., Teubner-Verlag, Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuflage. Maschinene		 Belt & chain drives
 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. Maschinenelemente, Band I-III; Niemann, G., 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 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.		Gear drives
 Silding 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 Cralculations 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. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Einführung in die DIN-Normer; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuellage. 		Epicyclic gears
 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 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. Maschinenelemente, 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. 		Crank drives
Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Calculations of hydrostatic systems (fluidics) Literature 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. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage.		Sliding bearings
 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 - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, ak Auflage. 		Elements of fluidics
 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, aktuflage. 		Exercise
 Axes & shafts Clutches & brakes 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, aktuellage. 		Calculation methods of the following machine elements:
 Clutches & brakes 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, aktuellage. 		Linear rolling bearings
 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, aktuellage. 		Axes & shafts
 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, aktuellage. 		Clutches & brakes
 Epicyclic gears 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, aktuellage. 		• 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, aktuellage. 		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, aktuellage. 		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, aktuellage. 		Crank gears
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, aktuellage.		Sliding bearings
 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, aktuellage. 		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, aktuellage. 	Literature	• Dubbel, Taschenbuch für den Maschinenbau: Grote, KH., Feldhusen, I.(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, aktuellage. 		
 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, ak 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, ak Auflage. 		
 Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, ak Auflage. 		
Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, ak Auflage.		
Auflage.		

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	
Title	Typ Hrs/wk CP
ntroduction 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 and functions of internal organs and the musculoskeletal system.
	The students can describe the basic macroscopy and microscopy of those systems.
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; the
	can explain the relevance of structures and their functions in the context of widespread diseases.
Personal Competence	
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquing
	the relevant knowledge themselves.
	Independent Study Time 62, Study Time in Lecture 28
Credit points	
Course achievement	
Examination	
Examination duration and	
scale	
-	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory
	Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory
	Engineering Science: Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
	Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory

urse L0384: Introduction t	to Anatomy		
Тур			
Hrs/wk			
СР			
	Independent 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					
Title		Тур	Hrs/wk	СР	
ntroduction to Radiology and Radi	ation Therapy (L0383)	Lecture	2	3	
Module Responsible	Prof. Ulrich Carl				
Admission Requirements	None				
Recommended Previous Knowledge	None				
	After taking part successfully, studen	ts have reached the following learning results			
Professional Competence					
Knowledge					
	The students can distinguish different	t types of currently used equipment with respect	to its use in radiation the	erapy.	
	The students can explain treatment p	lans used in radiation therapy in interdisciplinar	y contexts (e.g. surgery,	internal medicine).	
	The students can describe the pa	tients' passage from their initial admittanc	e through to follow-up	care.	
	Diagnostics				
	_	ical base concerns of projection radiography, it		d	
	well as sectional imaging techniques	hical base concepts of projection radiography, ir (CT, MRT, US).	iciuding anglography an	u mammograpny, a	
	The students can explain the diagnost techniques.	stic as well as therapeutic use of imaging techni	iques, as well as the tech	nnical basis for tho	
	The students can choose the right tre	atment method depending on the patient's clinic	cal history and needs.		
	The student can explain the influence	of technical errors on the imaging techniques.			
	The student can draw the right conclu	usions based on the images' diagnostic findings	or the error protocol		
	The student can draw the right conclusions based on the images' diagnostic findings or the error protocol.				
Skills	s 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 differen	nt kinds of radiation, can choose the best one	depending on the situa	tion (location of t	
	-	d in that situation (irradiation planning).			
	The student can assess what an inc groups, self-help groups, social service	dividual psychosocial service should look like (ces, psycho-oncology).	e.g. follow-up treatment	t, sports, social he	
	Diagnostics				
	The students can suggest solutions for	or repairs of imaging instrumentation after having	g done error analyses.		
	The students can classify results of anatomy, pathology and pathophysio	imaging techniques according to different grou logy.	ips of diseases based or	n their knowledge	
Borconal Competence					
Personal Competence Social Competence	The students can assess the special social situation of tumor patients and interact with them in a professional way. The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeut measures and can meet them appropriately.				
Autonomy	The students can apply their new kno	wledge and skills to a concrete therapy case.			
	The students can introduce younger s				
	The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the and acquire the relevant knowledge themselves.			rsations on the top	
Workload in Hours	Independent Study Time 62, Study Ti	me in Lecture 28			
Credit points					
Course achievement	None				
Examination					
Examination duration and scale	90 minutes				
	General Engineering Science (German	n program, 7 semester): Specialisation Biomedic	al Engineering: Compulso	ory	
Following Curricula	General Engineering Science (Gern	nan program, 7 semester): Specialisation Me	chanical Engineering, F	ocus Biomechanic	
	Compulsory	. Commulaan			
	Data Science: Specialisation Medicine Electrical Engineering: Specialisation	e: Compulsory Medical Technology: Elective Compulsory			
	Engineering Science: Specialisation B				
		ish program, 7 semester): Specialisation Me	chanical Engineering, F	ocus Biomechanic	
	Compulsory General Engineering Science (English	program, 7 semester): Specialisation Biomedica	l Engineering: Compulso	rv	
		program, 7 semester): Specialisation Biomedica			
	Mechanical Engineering: Specialisatio	n Biomechanics: Compulsory			
		n Medical Technology and Control Theory: Electi			

Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Тур	Lecture
Hrs/wk	2
СР	
	Independent Study Time 62, Study Time in Lecture 28
Lecturer Language	Prof. Ulrich Carl, Prof. Thomas Vestring
Cycle	
	The students will be given an understanding of the technological possibilities in the field of medical imagin interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of th 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
	1. Adnuge - Springer-Venag Gribh - erschlenen 02.00.2000

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, studer	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	en DNA and proteins;		
CL:III-	The shudents are			
SKIIIS	The students can			
	 recognize the importance of m 	nolecular parameters for the course of a disease;		
	 describe selected molecular-d 	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	el.	
Autonomy	The students can develop understan	ding of topics from the course, using technical liter	ature, by themselves.	
Workload in Hours	Independent Study Time 62, Study T	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: Compulsory	y
Following Curricula	General Engineering Science (Gen	man program, 7 semester): Specialisation Mech	hanical Engineering, Fo	cus Biomechanio
	Compulsory			
	Data Science: Specialisation Medicin			
		Medical Technology: Elective Compulsory		
	Engineering Science: Specialisation E	program, 7 semester): Specialisation Biomedical I	Engineering, Compulsory	
		lish program, 7 semester): Specialisation Biomedican		
	Compulsory	isin program, 7 semestery. Specialisation meet	lanical Engineering, 10	Sus Diomeenanie
	Mechanical Engineering: Specialisati	on Biomechanics: Compulsory		
		on Management and Business Administration: Elect	ive Compulsory	
	Biomedical Engineering: Specialisatio	on Artificial Organs and Regenerative Medicine: Ele	ctive Compulsory	
	Biomedical Engineering: Specialisatio	on Medical Technology and Control Theory: Elective	e Compulsory	
	Biomedical Engineering: Specialisation	on Implants and Endoprostheses: Elective Compuls	ory	

Course L0386: Introduction t	o 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
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 Al	rebra I + II for Te	chnomathematic
Knowledge	 basic MATLAB/Python knowledge 	german of englishy of Analysis a Enfeat Ag		ennomathematik
	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	Students are able to			
	 name numerical methods for interpolation, 	integration, least squares problems, eigenv	value problems, r	onlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the num 	nerical methods,		
	 explain aspects for the practical execution of 	of numerical methods with respect to comp	utational and stor	rage complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical m 	nethods using MATLAB/Python		
	 justify the convergence behaviour of numer 		nd solution algori	thm
	 select and execute a suitable solution appro 		na seración argen	,
Personal Competence				
Social Competence	Students are able to			
	 work together in heterogeneously compose 	d teams (i.e., teams from different study pr	ograms and bac	karound knowled
	explain theoretical foundations and support			
Autonomy	Students are capable			
	 to assess whether the supporting theoretica 	l and practical excercises are better solved	individually or in	a team.
	 to assess their individual progess and, if neo 		,	
Workload in Hours		re 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 minutes			
scale				
	General Engineering Science (German program, 7			
Following Curricula	General Engineering Science (German program	n, 7 semester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7			
	General Engineering Science (German program	, 7 semester): Specialisation Mechanica	i Engineering, F	ocus Biomecna
	Compulsory General Engineering Science (German program, 7	semester). Specialisation Mechanical Engin	eering Focus Th	enetical Mecha
	General Engineering Science (German program, 7 Engineering: Compulsory	semestery. Specialisation Mechanical Engli	icening, rocus III	corectar Metrid
		7 semester): Specialisation Mechanical	Engineering Foo	
	General Engineering Science German program		, 100	us Aircraft Svet
	General Engineering Science (German program, Engineering: Elective Compulsory			us Aircraft Syst
	Engineering: Elective Compulsory		neering, Focus M	
			neering, Focus M	
	Engineering: Elective Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical Engli		echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory	semester): Specialisation Mechanical Engli		echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program,	semester): Specialisation Mechanical Engin 7 semester): Specialisation Mechanical I	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory	semester): Specialisation Mechanical Engin 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulse	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical f Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory ry	Engineering, Foc	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 s	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory	Engineering, Foc vry ory	echatronics: Elec
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 Science (English program, 7 Science) English program, 7 Science (English program, 7 Science) Engineering Science (English program, 7 Science) English program, 7 Science (English program, 7 Science) English program	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science	Engineering, Foc nry pry : Compulsory	echatronics: Elec us Energy Syste
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science	Engineering, Foc nry pry : Compulsory	echatronics: Elec us Energy Syste
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Scompulsory	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry remester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical	Engineering, Foc ory ory : Compulsory Engineering, F	echatronics: Elec us Energy Syste ocus Biomecha
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 Scompulsory	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry remester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical	Engineering, Foc ory ory : Compulsory Engineering, F	echatronics: Elec us Energy Syste ocus Biomecha
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 Sciences: Compulsory	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat	echatronics: Elec us Energy Syste ocus Biomecha eerials in Enginee
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat	echatronics: Elec us Energy Syste ocus Biomecha eerials in Enginee
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Engineering: Compulsory	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical E Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry remester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat eeering, Focus Th	echatronics: Elec us Energy Syste ocus Biomecha erials in Enginee eoretical Mecha
	Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7	semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulsor	echatronics: Elec us Energy Syste ocus Biomecha eerials in Enginee eoretical Mecha

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	ourse L0417: Numerical Mathematics I				
Тур	Lecture				
Hrs/wk					
CP					
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Lecturer	Prof. Sabine Le Borne				
Language	EN				
Cycle	WiSe				
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 				
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 				

Course L0418: Numerical Ma	rse 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				
Courses Title		Tun	Hrs/wk	СР
Incle Implants and Fracture Healing (L03	76)	Typ Lecture	ПГ5/WK 2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Intro	duction into Anatomie" before attending "Imp	plants and Fracture Heal	ing".
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students can describe the different w	ays how bones heal, and the requirements fo	or their existence.	
	The students can name different treatme	nts for the spine and hollow bones under give	en fracture morphologies	i.
Skills	The students can determine the forces a	ting within the human body under quasi-stati	ic situations under speci	fic assumptions.
Personal Competence				
Social Competence	The students can, in groups, solve basic r	numerical modeling tasks for the calculation o	of 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	program, 7 semester): Specialisation Med	chanical Engineering, F	ocus Biomechani
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory			ory
	Engineering Science: Specialisation Biom			
		gram, 7 semester): Specialisation Biomedical		-
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biome			
	Compulsory			
	Mechanical Engineering: Specialisation Bi	omechanics: Compulsory		
	Biomedical Engineering: Specialisation In	plants and Endoprostheses: Elective Compute	sory	
		tificial Organs and Regenerative Medicine: El		
	Biomedical Engineering: Specialisation M	anagement and Business Administration: Elec	tive Compulsory	
	Biomedical Engineering: Specialisation M	edical Technology and Control Theory: Electiv	e Compulsory	
	Orientation Studies: Core Qualification: El	lective Compulsory		

Course L0376: Implants and	Fracture Healing
-	Lecture
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE
Cycle	WiSe
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	
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		d 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- 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 Insut/output, 1/O from the parametrize of the CPU, principles of passing data, point to point compacting, burger 				
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 physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based or collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comput system and the software executed on it. In particular, they shall understand the consequences that the execution of software how the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evalua the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. 				
Personal Competence					
Social Competence	Students are able to solve similar problems alone or	r in a group and to present the results a	cordingly.		
Autonomy	Students are able to acquire new knowledge from s	pecific literature and to associate this ki	nowledge with othe	r classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Course achievement	Compulsory Bonus Form Description				
	Yes 10 % Excercises				
Examination	Written exam				
Examination duration and	90 minutes, contents of course and labs				
scale					
Assignment for the					
Following Curricula					
	General Engineering Science (German program, 7 s				
	General Engineering Science (German program,	/ semester): Specialisation Mechan	cal Engineering, I	-ocus Mechatroni	
	Compulsory	7 compostor), Specialization Machanics	L Engineering For	un Aircraft Sucto	
	General Engineering Science (German program, Engineering: Compulsory	7 semester): specialisation Mechanica	i Engineering, Foc	us Aircrait Syste	
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical En	aineerina. Focus Th	eoretical Mechani	
	Engineering: Compulsory		jineering, roedo rii		
	General Engineering Science (German program,	, 7 semester): Specialisation Mecha	nical Engineering,	Focus Materials	
	Engineering Sciences: Compulsory				
	General Engineering Science (German program, 7	semester): Specialisation Mechanical E	ngineering, Focus P	roduct Developm	
	and Production: Compulsory				
	General Engineering Science (German program, Compulsory	7 semester): Specialisation Mechanica	I Engineering, Foc	us Energy Syster	
	General Engineering Science (German program,	7 semester): Specialisation Mechani	cal Engineering. F	ocus Biomechani	
	Compulsory		<u> </u>		
	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s Compulsory	emester): Specialisation Biomedical Eng emester): Specialisation Bioprocess Eng emester): Specialisation Electrical Engir	ineering: Compulso ineering: Compulso eering: Compulsory	ory /	
	Computer Science: Core Qualification: Compulsory				
	Data Science: Core Qualification: Elective Compulso	ry			
	Electrical Engineering: Core Qualification: Compulso	ry			
	General Engineering Science (English program, 7 se				
	General Engineering Science (English program, Compulsory	7 semester): Specialisation Mechani	cal Engineering, F	ocus Biomechan	
	General Engineering Science (English program, Compulsory General Engineering Science (English program, 7	·			

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
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	gineering
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/EN
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	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/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 ha	we reached the following learning results			
Professional Competence					
Knowledge	The students can				
	 describe the basics of the energy n 	netabolism:			
		selected fields of muscle, heart/circulation, r	neuro- and sensory physic	ology.	
Skills		basic bodily functions (sensory, transmission	n and processing of inform	mation, developm	
D	of forces and vital functions) and relate th	iem to similar technical systems.			
Personal Competence	The students can conduct discussions in s	eccevel and medicine on a technical layer			
Social Competence The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrological.					
	The students can find solutions to problem	in the field of physiology, both analytical	and metrological.		
Autonomy The students can derive answers to questions arising in the course and other physiological areas, using techn				chnical literature	
	themselves.				
Workload in Hours	Independent Study Time 62, Study Time i	n Lecture 28			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and	60 minutes				
scale					
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Biomedic	al Engineering: Compulso	ory	
Following Curricula	General Engineering Science (German	program, 7 semester): Specialisation Me	echanical Engineering, F	ocus Biomechan	
	Compulsory				
	Data Science: Specialisation Medicine: Co	mpulsory			
	Electrical Engineering: Specialisation Med				
	Engineering Science: Specialisation Biome				
		program, 7 semester): Specialisation Me	chanical Engineering, F	ocus Biomechan	
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory				
	Mechanical Engineering: Specialisation Biomechanics: Compulsory				
	Biomedical Engineering: Specialisation Biomechanics: compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory				
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory				
		tificial Organs and Regenerative Medicine: E			
	Biomedical Engineering: Specialisation Im	plants and Endoprostheses: Elective Compu	llsory		
	Technomathematics: Specialisation III. En	gineering Science: Elective Compulsory			

Course L0385: Introduction t	ourse L0385: Introduction to Physiology		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Gerhard Engler		
Language	DE		
Cycle	ie		
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		Тур	Hrs/wk	СР	
Experimental Methods in Biomecha	nics (L0377)	Lecture	2	3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous	It is recommended to participate in "Imp	lantate und Frakturheilung" before attending	"Experimentelle Methode	en".	
Knowledge					
Educational Objectives	After taking part successfully, students h	nave reached the following learning results			
Professional Competence					
Knowledge	The students can describe the different v	ways how bones heal, and the requirements f	or their existence.		
	The students can name different treatme	ents for the spine and hollow bones under giv	en fracture morphologies		
	The students can describe different mea	surement techniques for forces and moveme	nts and choose the adec	wate technique fo	
	The students can describe different measurement techniques for forces and movements, and choose the adequate technique given task.				
	J				
Skills	The students can describe the basic handling of several experimental techniques used in biomechanics.				
Personal 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	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Me	chanical Engineering, F	ocus Biomechan	
Following Curricula	Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory				
	Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics				
	Compulsory				
		ogram, 7 semester): Specialisation Biomedica		-	
		ogram, 7 semester): Specialisation Biomedica	I Engineering: Elective C	ompulsory	
	Mechanical Engineering: Specialisation B Technomathematics: Specialisation III. E				

Course L0377: Experimental	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		

Madula M0024, Adua				
Module M0934: Adva	nced Materials			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Characterization (L1087)		Lecture	2	2
Advanced Materials Design (L1091)	Lecture	2	2
Advanced Materials Design (L1092)	Recitation Section (large)	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 have	reached the following learning results		
Professional Competence				
Knowledge	The students will be able to explain the prop	erties of advanced materials along with the	ir applications in tech	hnology, in particul
	metallic, ceramic, polymeric, semiconductor,	modern composite materials (biomaterials)	and nanomaterials.	
Skille	The students will be able to select material	configurations according to the technical	noods and if noso	scany to dosign no
SKIIIS	<i>Skills</i> The students will be able to select material configurations according to the technical needs and, if necessary, to des materials considering architectural principles from the micro- to the macroscale. The students will also gain an ove modern materials science, which enables them to select optimum materials combinations depending on the technical appl			
	modern materials science, which enables the		depending on the te	
Personal Competence				
Social Competence	The students are able to present solutions to specialists and to develop ideas further.			
Autonomy	The students are able to			
	 assess their own strengths and weakned 	255.25		
	 define tasks independently. 	=>>=>>=>		
	• define tasks independently.			
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Mecha	nical Engineering, F	Focus Biomechanic
Following Curricula			5 5,	
-	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mech	anical Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	Data Science: Specialisation Materials Science	e: Compulsory		
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical Er	igineering: Elective C	Compulsory
	Mechanical Engineering: Core Qualification: E			

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

Course L1091: 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. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller, Prof. Patrick Huber, Prof. Stefan Fritz Müller		
Language	DE/EN		
Cycle	SoSe		
Content			
Literature	Vorlesungsunterlagen		

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

Focus Energy Systems

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

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

-					
Courses					
Title		Тур	Hrs/wk	СР	
Computer Engineering (L0321) Computer Engineering (L0324)		Lecture Recitation Section (small)	3 1	4	
Module Responsible	Prof Hoiko Falk	Accitation Section (Sinally	1	L	
Admission Requirements					
-	Basic knowledge in electrical engineering				
Knowledge	basic knowledge in electrical engineering				
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence	······				
-	This module deals with the foundations of the fun	ctionality of computing systems. It cover	s the lavers fron	n the assembly-lev	
	programming down to gates. The module includes t				
	Introduction				
	 Combinational logic: Gates, Boolean algebra, 	Boolean functions hardware synthesis of	mbinational net	works	
	 Sequential logic: Flip-flops, automata, system 				
	Technological foundations	5			
	Computer arithmetic: Integer addition, subtra	action, multiplication and division			
	Basics of computer architecture: Programmin	g 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-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	
	composition of computer systems. The students can analyze, how highly specific and individual computers can be built be				
	collection of few and simple components. They are	able to distinguish between and to expla	ain the different	abstraction layers	
	today's computing systems - from gates and circuits	s up to complete processors.			
	After successful completion of the module, the stu	idents are able to judge the interdepend	encies between	a physical comput	
	system and the software executed on it. In particul				
	on the hardware-centric abstraction layers from the				
	the impact that these low abstraction levels have or				
Deveenel Commetence					
Personal Competence	Students are able to solve similar problems alone or	in a group and to procent the results acc	ordinaly		
Social competence	Students are able to solve similar problems alone of	in a group and to present the results act	orunigiy.		
Autonomy	Students are able to acquire new knowledge from s	pecific literature and to associate this know	wledge with othe	r classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture	2 56			
Credit points	6				
Course achievement		Description			
	Yes 10 % Excercises				
Examination					
	90 minutes, contents of course and labs				
scale					
Assignment for the					
Following Curricula	General Engineering Science (German program, 7 s		. .	or y	
	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s			1	
	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 s		-	5	
	General Engineering Science (German program,		5 1 5	Focus Mechatronic	
	Compulsory		2 5,		
	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering, F	ocus Biomechanic	
	Compulsory				
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foo	us Aircraft System	
	Engineering: Compulsory				
	General Engineering Science (German program,	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials	

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

Course L0321: Computer 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/EN
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	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/EN	
Cycle	WiSe	
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
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	None			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge	After taking part successfully, students have reached th	following loorning results		
Professional Competence	After taking part successfully, students have reached the	rollowing learning results		
-	The students are able to			
	- describe the different physical mechanism of Heat Trar	sfer,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical v	vay.		
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer processe	S,		
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and dev	elop an approach.		
Autonomy	The students are able to develop a complex problem se	f-consistent and analyse the results i	in a critical way. A	A qualified exchar
	with other students is given.	·····	,	1
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 min			
scale				
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical	Engineering, Foc	us Energy System
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Energy Systems: Technical Complementary Course Core	Studies: Elective Compulsory		
	General Engineering Science (English program, 7 ser	nester): Specialisation Mechanical	Engineering, Foc	us Energy Syste
	Compulsory			
	General Engineering Science (English program, 7 semes	er): Specialisation Biomedical Engine	eering: Compulso	ry
	Mechanical Engineering: Specialisation Energy Systems:	Compulsory		
	Mechanical Engineering: Specialisation Theoretical Mech	anical Engineering: Elective Compuls	orv	

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		

Course L0459: Heat Transfer	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	
	ines and Turbomachinery - Part Reciprocating Engines (L0633)	Lecture	1	1	
	ines and Turbomachinery - Part Reciprocating Engines (L0634)	Recitation Section (large)	1	1	
Internal Combustion Engines I (L00		Lecture Recitation Section (large)	2	2 2	
Internal Combustion Engines I (L06		Recitation Section (large)	T	Z	
Module Responsible	Prof. Christopher Friedrich Wirz				
Admission Requirements	None				
Recommended Previous	Thermodynamics, Mechanics, Machine Elements				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follo	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 regardi	
	power and working machinery and describe the qualitative a	and quantitative correlations of o	operating method	is and efficiencies	
	multiple types of engines, compressors and pumps. They a	re able to utilize technical term	s and parameter	s as well as aspec	
	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 rela	ted and operation	nal problems.	
	As a result of the part module "Internal Combustion Engi	nos I" the students are able r	aflact and utilize	the state of the a	
	regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic				
	characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems Detailed knowledge is present regarding computer-aided process design.				
	becalled knowledge is present regarding computer-aided pro	cess design.			
Skills	s The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operatior				
	They are further able to assess, analyse and solve technical and operational problems and to perform mechanical an				
	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 thei	r future professio	n independently a	
Autonomy	The widespread scope of gained knowledge enables the students to handle situations in their future profession independently and confidently.				
	connectity.				
Werkland in Heure	Independent Study Time 110 Study Time in Lecture 70				
	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Mechanical	Engineering, Foc	us Energy System	
Following Curricula	Compulsory				
	Energy and Environmental Engineering: Core Qualification: El	lective Compulsory			
	Energy Systems: Technical Complementary Course Core Stud	lies: Elective Compulsory			
	General Engineering Science (English program, 7 semester	er): Specialisation Mechanical I	Engineering, Foc	us Energy System	
	Compulsory				
	Green Technologies: Energy, Water, Climate: Specialisation E	nergy Technology: Elective Com	pulsory		
	Mechanical Engineering: Specialisation Energy Systems: Com	and a second			

Тур	Lecture
Hrs/wk	1
CP	1
	Independent Study Time 16, Study Time in Lecture 14
	Prof. Christopher Friedrich Wirz
Language	
Cycle	
Content	 Verbrennungsmotoren Historischer Rückblick Einteilung der Verbrennungsmotoren Arbeitsverfahren Vergleichsprozesse Arbeit, Mitteldrücke, Leistungen Arbeitsprozess des wirklichen Motors Wirkungsgrade Gemischbildung und Verbrennung Motorkennfeld und Betriebskennlinien Abgasentgiftung Gaswechsel Aufladung Kühl- und Schmiersystem Kräfte im Triebwerk Kolbenverdichter Thermodynamik des Kolbenverdichters Einteilung und Verwendung
	Kolbenpumpen Drinzin der Kelhenpumpen
	Prinzip der Kolbenpumpen Finfeilung und Verwendung
	Einteilung und Verwendung
Literature	A. Urlaub: Verbrennungsmotoren

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

Course L0059: Internal 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					
Title		Turn	Hre /wk	СР	
		Typ Lecture	Hrs/wk 2	2	
Advanced Mechanical Engineering I Advanced Mechanical Engineering I		Recitation Section (large)	2	1	
Advanced Mechanical Engineering I		Lecture	2	2	
Advanced Mechanical Engineering I	-	Recitation Section (large)	2	1	
Module Responsible					
Admission Requirements					
Recommended Previous					
Knowledge	 Fundamentals of Mechanical Engineering 	g Design			
Kilowieuge	Mechanics				
	Fundamentals of Materials Science				
	Production Engineering				
	After taking part successfully, students have re	ached the following learning results			
Professional Competence					
Knowledge	After passing the module, students are able to:				
	explain complex working principles and	functions of machine elements and of basic ele	ements of fluidics	,	
	 explain requirements, selection criteria, 	application scenarios and practical examples	of complex machi	ine elements,	
	 indicate the background of dimensioning 	calculations.			
Skills	After passing the module, students are able to:				
	accomplich dimensioning calculations of covered machine elements				
	 accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), 				
			iving skills),		
	recognize the content of technical drawings and schematic sketches,				
	 evaluate complex designs, technically. 				
Personal Competence					
Social Competence					
Social competence	 Students are able to discuss technical in 	formation in the lecture supported by activating	ng methods.		
Autonomi					
Autonomy	 Students are able to independently deepen their acquired knowledge in exercises. 				
	• Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the vid				
	recordings of the lectures.				
Workload in Hours	Independent Study Time 68, Study Time in Lec	ture 112			
Credit points	6				
Course achievement	None				
Examination					
Examination duration and	120				
scale					
-	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
Following Curricula	a General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems				
	Compulsory				
	Energy and Environmental Engineering: Core Q	ualification: Elective Compulsory			
	Energy Systems: Technical Complementary Con	urse Core Studies: Elective Compulsory			
	Engineering Science: Specialisation Mechanical	Engineering: Compulsory			
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Engin	eering: Compulso	ry	
	General Engineering Science (English progra	m, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syster	
	Scherdi Engliseering Science (English produ				
	Compulsory		5 5.	5,7 ,	
			5 5.	5, ,	

Course L0264: Advanced Med	chanical Engineering Design II
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)
	• Calculations of hydrostatic systems (induce)
Literature	Dubbal Teachadach für den Marshinghau Crobe IV. L. Feldburge L(Uner). Gedaren Verlag, alter H. A. flage
	 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 Me	Course L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

se L0262: Advanced Me	chanical Engineering Design I
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	DE
Cycle	WiSe
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	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)
	- concurations of hydroscolic systems (nonics)
Literature	 Dubbal Taschaphuch für den Maschinaphaus Crote K. H. Feldhusen I. (Hrsg.): Springer Verlag, aktuelle Auflage
	 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, 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 Me	Course L0263: Advanced Mechanical Engineering Design I	
Тур	Recitation Section (large)	
Hrs/wk		
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Tun	Hrs/wk	СР
Computational Fluid Dynamics I (L	235)	Typ 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 cale 	culus and series expansions		
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics	of partial differential equations.		
Skills	The students are able develop appropriate num	nerical integration in space and time for the g	overning partial d	lifferential equatio
	They can code computational algorithms in a st	ructured way.		
Borconal Compotonco				
Personal Competence	The students can arrive at work results in group	as and document them		
Social Competence	The students can arrive at work results in group	ss and document them.		
Automore	The students can independently applying approx	a character and sing an a sific problems		
Autonomy	The students can independently analyse approa	aches to solving specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lee	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechani
Following Curricula	Engineering: Elective Compulsory			
	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syste
	Engineering: Elective Compulsory			
	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syster
	Elective Compulsory			
	General Engineering Science (German program			
	General Engineering Science (German program		romental Enginee	ring: Compulsory
	Energy Systems: Technical Complementary Cou General Engineering Science (English program,		omental Engineer	ing: Compulsory
	General Engineering Science (English program, General Engineering Science (English program)		-	
	Elective Compulsory	, , semester, specialisation methallical	Lighteening, 100	as Energy Syster
	General Engineering Science (English program,	7 semester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (English program, General Engineering Science (English program)			us Aircraft Syste
	Engineering: Elective Compulsory	,,,		
	Mechanical Engineering: Specialisation Energy	Systems: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft	Systems Engineering: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft Naval Architecture: Core Qualification: Compuls			

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	Cycle Wise Content Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms. 1. Partial differential equations 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 10. 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	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	None			
Recommended Previous	 Mathematik I + II for Engineering Students (g) 	erman or english) or Analysis & Linear Ald	aebra I + II for Te	chnomathematic
Knowledge	basic MATLAB/Python knowledge			
-	After taking part successfully, students have reache	d the following learning results		
Professional Competence	Students are able to			
Knowledge	Students are able to			
	 name numerical methods for interpolation, in 	ntegration, least squares problems, eigenv	value problems, r	onlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the nume 			
	 explain aspects for the practical execution of 	numerical methods with respect to compo	utational and stor	rage complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical me 	ethods using MATLAB/Python,		
	 justify the convergence behaviour of numeric 	al methods with respect to the problem a	nd solution algori	thm,
	 select and execute a suitable solution approx 	ch for a given problem.		
Personal Competence				
•	Students are able to			
boelar competence				
	 work together in heterogeneously composed 	teams (i.e., teams from different study pr	ograms and bac	kground knowled
	explain theoretical foundations and support e	each other with practical aspects regarding	g the implementa	tion of algorithm
Autonomv	Students are capable			
,				
	 to assess whether the supporting theoretical 		individually or in	i a team,
	 to assess their individual progess and, if nece 	essary, to ask questions and seek help.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	2 56		
Credit points				
Course achievement				
	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 s	emester): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program			Focus Material
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 s	emester): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering, F	ocus Biomecha
	Compulsory			
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mecha
	Engineering: Compulsory			
	General Engineering Science (German program,	/ semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syst
	Engineering: Elective Compulsory General Engineering Science (German program, 7 s	omostor), Specialization Machanical Franci	pooring Ecours	ochatronica: El-
	General Fugureeung Science German program 7 /	emester: specialisation Mechanical Engli	ieening, rocus M	
				echacionics. Liet
	Compulsory		Engineering Foc	
	Compulsory General Engineering Science (German program,		Engineering, Foc	
	Compulsory General Engineering Science (German program, Elective Compulsory	7 semester): Specialisation Mechanical I		
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso		
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory	iry	
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory	iry	
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics and	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso	iry	
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory	iry	
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory	iry	
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory	iry	
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science	ry pry : Compulsory	us Energy Syste
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science	ry pry : Compulsory	us Energy Syste
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical	ory ory : Compulsory Engineering, F	us Energy Syste ocus Biomechae
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical	ory ory : Compulsory Engineering, F	us Energy Syste ocus Biomechae
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	ory ory Compulsory Engineering, F eering, Focus Mat	us Energy Syste ocus Biomechai erials in Enginee
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	ory ory Compulsory Engineering, F eering, Focus Mat	us Energy Syste ocus Biomechai erials in Enginee
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine	ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th	us Energy Syste ocus Biomechai erials in Enginee eoretical Mechai
	Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory ad Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine	ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso	us Energy Syste ocus Biomechai erials in Enginee eoretical Mechai

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	Course L0417: Numerical Mathematics I		
Тур	Lecture		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne		
Language	EN		
Cycle	WiSe		
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 		
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 		

Course L0418: Numerical Ma	urse 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
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 comp	exe numbers, integrals, differentials		
Knowledge	Basics of electrical engineering and mecha	anical engineering		
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basi	c principles of electric and magnetic fields.		
	They can describe the function of the	standard turnes of clastic machines and pro	cont the correspond	dina aquationa a
	-	standard types of electric machines and pre ives they can explain the major parameters of th		
	from the power grid to the driven engine.	ives they can explain the major parameters of th	le energy enterency	of the whole syste
Skills	Students are able to calculate two-dimen	sional electric and magnetic fields in particular	ferromagnetic circu	uits with air gap.
	this they apply the usual methods of the d	esign auf electric machines.		
	They can calulate the operational perform	nance of electric machines from their given cha	racteristic data and	d selected quantit
		usual equivalent circuits and graphical methods.		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calcul	ate electric and magnatic fields for applications.	They are able to ar	nalyse independer
	nomy Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected and the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the operational performance of electr			f selected quantit
	and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Design of four machines and actuators, re-	view of design files		
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Electrical Engi	neering: Elective Co	mpulsory
Following Curricula	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanica	al Engineering, Foc	us Energy Syster
	Compulsory			
		program, 7 semester): Specialisation Mechan	ical Engineering, I	Focus Mechatron
	Compulsory	gram, 7 semester): Specialisation Mechanical En	ginopring Focus Th	anatical Machani
	Engineering: Elective Compulsory	gram, 7 semester). Specialisation Mechanical En	gineering, rocus ri	
	Digital Mechanical Engineering: Core Qual	fication: Compulsory		
	Electrical Engineering: Core Qualification:			
	Energy and Environmental Engineering: Co			
	General Engineering Science (English prog	ram, 7 semester): Specialisation Mechanical Eng	ineering: Elective C	ompulsory
	Green Technologies: Energy, Water, Clima	te: Specialisation Energy Technology: Elective Co	ompulsory	
	Logistics and Mobility: Specialisation Engir	eering Science: Elective Compulsory		
	5 , 1	c Planning and Systems: Elective Compulsory		
		uction Management and Processes: Elective Com	pulsory	
	Mechanical Engineering: Core Qualification			
	Mechatronics: Core Qualification: Compuls	•		
	Technomathematics: Specialisation III. Eng	ineering Science: Elective Compulsory		
	Engineering and Management - Major in Lo	ogistics and Mobility: Specialisation Traffic Planni Logistics and Mobility: Specialisation Productio		

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
CP	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 Industry (L0315) Renewable Energy (L0313)		Lecture Lecture	2	2 2
Renewable Energy (L1434)		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
•	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	With completion of this module, the students can p efficiency. They can explain the issues occurring in th distribution and power trading wih regard to sub applicable to many energy systems in general, esp the students can explain the environmental benefits	his context. Furthermore, they can explai oject-related contexts. The students ca ecially for renewable energy systems an	n details of powe n explain these	r generation, pow aspects, which a
	 Students are able to apply methodologies for detailed determination of energy demand or energy production for various types energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design the under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for r standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies or and to put them them into the right context. 			
Personal Competence				
	The students are able to analyze suitable technica criteria under sustainability aspects. This allows then			
Autonomy	Students can independently exploit sources , acqui questions.	ire the particular knowledge about the s	subject area and	transform it to n
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	34		
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 se	emester): Specialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Process Engineer	ing: Compulsory	
	General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Foc	us Energy Syster
	Elective Compulsory	Civil Engineering: Elective Course?		
	Civil- and Environmental Engineering: Specialisation			
	Civil- and Environmental Engineering: Specialisation	iramic and Mobility: Elective Compulsory		
	Chill and Environmental Environmental Control Post	Water and Environment Election C	leen	
	Civil- and Environmental Engineering: Specialisation Energy and Environmental Engineering: Core Qualific		lsory	

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	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	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
Content	Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy
Literature	 Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - Systemtechnik, Wirtschaftlichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007

Focus Aircraft Systems Engineering

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

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

Courses				
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
		Reclation Section (large)	2	1
Module Responsible				
Admission Requirements Recommended Previous				
Knowledge	 Eundamentals of Mechanical Engineering 	ng Design		
Riomeuge	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have i	reached the following learning results		
Professional Competence				
-	After passing the module, students are able to	0:		
	······			
		d functions of machine elements and of basic e		
		a, application scenarios and practical examples	of complex maching	ine elements,
	 indicate the background of dimensionir 	ig calculations.		
Skills	After passing the module, students are able to	0:		
	- commist dimensioning coloulations	of covered machine elements		
	 accomplish dimensioning calculations of transfer knowledge learned in the mod 		lving skills)	
	 transfer knowledge learned in the mod recognize the content of technical draw 	lule to new requirements and tasks (problem so wings and schematic sketches	Jiving skins),	
	 recognize the content of technical draw evaluate complex designs, technically. 			
	• evaluate complex designs, technicary.			
Personal Competence				
Social Competence	 Students are able to discuss technical. 	information in the lecture supported by activati	ing methods	
	• Students are able to discuss technicari	mornation in the lecture supported by activat	ing methods.	
Autonomy	, • Students are able to independently dev	epen their acquired knowledge in exercises.		
		al knowledge and to recapitulate poorly under	rstood content e c	, by using the vi
	recordings of the lectures.	in knowledge and to recupitalate poorly ander	stobu content e.g	. by using the vi
Workload in Hours	Independent Study Time 68, Study Time in Le	cture 112		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120			
scale				
Assignment for the	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical Engi	ineering: Compuls	ory
Following Curricula	General Engineering Science (German pro	gram, 7 semester): Specialisation Mechanic	al Engineering, I	Focus Biomechan
	Compulsory		Facility of the Fac	E
		gram, 7 semester): Specialisation Mechanical	Engineering, Foo	us Energy System
	Compulsory	gram, 7 semester): Specialisation Mechanical	Engineering Eq	aug Aircraft Syste
	Engineering: Compulsory	ian, 7 semester, specialisation mechanical	Lingineering, 100	Lus Anciait Syste
		ogram, 7 semester): Specialisation Mechan	ical Engineering	Focus Materials
	Engineering Sciences: Compulsory	ygrani, / Schester, Specialisation reenali	icai zrigineering,	
		gram, 7 semester): Specialisation Mechanic	al Engineering,	Focus Mechatron
	Compulsory	5	5 5.	
	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical En	gineering, Focus F	Product Developm
	and Production: Compulsory			
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	neoretical Mechan
	Engineering: Compulsory			
	Engineering: Compulsory Energy Systems: Technical Complementary C	ourse Core Studies: Elective Compulsory		
	Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic		neering: Compulso	pry
	Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English program	al Engineering: Compulsory	÷ .	-
	Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English program General Engineering Science (English prog Compulsory	al Engineering: Compulsory n, 7 semester): Specialisation Mechanical Engir gram, 7 semester): Specialisation Mechanic	al Engineering, F	Focus Biomechan
	Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English program General Engineering Science (English progr Compulsory General Engineering Science (English progr	al Engineering: Compulsory n, 7 semester): Specialisation Mechanical Engir	al Engineering, F	Focus Biomechar
	Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English progran General Engineering Science (English progr Compulsory General Engineering Science (English progr Compulsory	al Engineering: Compulsory n, 7 semester): Specialisation Mechanical Engir gram, 7 semester): Specialisation Mechanic	al Engineering, F	Focus Biomechar

Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Mechanical Engineering: Core Qualification: Compulsory
Naval Architecture: Core Qualification: Compulsory

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
	• Elements of hubbles
	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 Teachadach für den Maaskinghen, Orste 17. H. Feldburgen 17. Hern Vielan, staate staate
	 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

qyT	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 - 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	Typ Hrs/wk CP
Advanced Mechanical Design Proje	
Module Responsible	Dr. Jens Schmidt
Admission Requirements	None
Recommended Previous	Mechanical Engineering: Design
Knowledge	Advanced Mechanical Engineering Design
	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module, students are able to:
	express the procedure for systematically handling of
	• complex design tasks ,
	 describe working principles, their use and combination possibilities,
	 explain guidelines for designing for function and manufacturing,
	 explain advanced use-oriented knowledge of machine elements.
Skills	After passing the module, students are able to:
	analyze complex tasks and develop principle solutions using sketches,
	 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.
Deveral Competence	
Personal Competence	After passing the module, students are able to:
Social competence	Alter 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:
	 independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select appropriate methods,
	 to independently solve problems.
	Independent Study Time 124, Study Time in Lecture 56
Credit points	6 Compulsory Bonus Form Description
Course achievement	Yes None Attestation
Examination	Written exam
Examination duration and	180
scale	
Assignment for the	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 Developme
	and Production: 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 Mechani
	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
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 reach	ned the following learning results		
Professional Competence				
Knowledge	This module deals with the foundations of the fu programming down to gates. The module includes • Introduction		ers the layers fron	the assembly-le
	 Introduction Combinational logic: Gates, Boolean algebra Sequential logic: Flip-flops, automata, syste Technological foundations Computer arithmetic: Integer addition, subt Basics of computer architecture: Programm Memories: Memory hierarchies, SRAM, DRA Input/output: I/O from the perspective of the 	matic hardware design raction, multiplication and division ing models, MIPS single-cycle architecture M, caches	, pipelining	
Skills	The students perceive computer systems from the composition of computer systems. The students construction of few and simple components. They a today's computing systems - from gates and circu After successful completion of the module, the s system and the software executed on it. In partici- on the hardware-centric abstraction layers from the the impact that these low abstraction levels have	an analyze, how highly specific and individ re able to distinguish between and to exp its up to complete processors. tudents are able to judge the interdeper ular, they shall understand the consequer ne assembly language down to gates. This	dual computers can blain the different indencies between inces that the exect s way, they will be	h be built based o abstraction layers a physical compu- ution of software l enabled to evalue
Demonstration of the second se				
Personal Competence	Students are able to solve similar problems along	or in a group and to procent the results as	cordinaly	
Social Competence	Students are able to solve 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 kn	owledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Course achievement	Compulsory Bonus Form	Description		
	Yes 10 % Excercises			
Examination	Written exam			
Examination duration and	90 minutes, contents of course and labs			
scale				
Assignment for the				
Following Curricula				
	General Engineering Science (German program, 7			
	General Engineering Science (German program	n, 7 semester): Specialisation Mechanic	cal Engineering, I	ocus Mechatroni
	Compulsory	7 competer), Enocialization Machanical	Engineering For	ue Aircraft Sucto
	General Engineering Science (German program, Engineering: Compulsory	/ semester): specialisation Mechanical	Engineering, Foc	us Aircrait Syste
	General Engineering Science (German program, 7	semester): Specialisation Mechanical End	ineerina. Focus Th	eoretical Mechani
	Engineering: Compulsory	English and the second s	g, 10005 Th	
	General Engineering Science (German program	n, 7 semester): Specialisation Mechan	ical Engineering,	Focus Materials
		n, 7 semester): Specialisation Mechan	ical Engineering,	Focus Materials
	General Engineering Science (German program			
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory	7 semester): Specialisation Mechanical En	gineering, Focus P	roduct Developm
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical En	gineering, Focus P	roduct Developme
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical	gineering, Focus P Engineering, Foc	roduct Developm us Energy Syster
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical	gineering, Focus P Engineering, Foc	roduct Developm us Energy Syster
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine	gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory	roduct Developm us Energy Syster ocus Biomechani pry ry
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo	gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory	roduct Developm us Energy Syster ocus Biomechani yry ry
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo	gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory	roduct Developm us Energy Syster ocus Biomechani yry ry
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo	gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory	roduct Developm us Energy Syster ocus Biomechani yry ry
	General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulse	7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo , sory sory semester): Specialisation Civil Engineering	gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory gies, Focus Renew	roduct Developm us Energy Syster ocus Biomechan my ry ry able Energy: Elect

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
Computational Science and Engineering: Core Qualification: Compulsory
Mechatronics: Core Qualification: Compulsory
Technomathematics: Specialisation II. Informatics: Elective Compulsory

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

Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (L		Lecture	2	3
Computational Fluid Dynamics I (L		Recitation Section (large)	2	3
Module Responsible				
Admission Requirements	None			
Recommended Previous	 Mathematical Methods for Engineers 			
Knowledge	 Fundamentals of Differential/integral calculu 	is and series expansions		
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	The students are able to list the basic numerics of	partial differential equations.		
SKIIIS	The students are able develop appropriate numeric		overning partial d	ifferential equation
	They can code computational algorithms in a struct	tured way.		
Personal Competence				
Social Competence	The students can arrive at work results in groups a	nd document them.		
Autonomy	The students can independently analyse approache	es to solving specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechanio
Following Curricula	Engineering: Elective Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syster
	Engineering: Elective Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Elective Compulsory			
	General Engineering Science (German program, 7 s	•		ing Compulsor
	General Engineering Science (German program, 7 s Energy Systems: Technical Complementary Course		omentai Engineei	ing: compulsory
	General Engineering Science (English program, 7 s		mental Engineeri	ing: Compulsory
	General Engineering Science (English program, 7 s			
	Elective Compulsory		J	
	General Engineering Science (English program, 7 s	emester): Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (English program,		1	us Aircraft Syster
	Engineering: Elective Compulsory	•		
	Mechanical Engineering: Specialisation Energy Syst	tems: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft Sys	tems Engineering: Elective Compulsory		
	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	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 Technomathematic here MATLAP (Dither leaveledge)
	basic MATLAB/Python 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 fil
	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
D.M.D	
	 implement, apply and compare numerical methods using MATLAB/Python,
	 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 knowle
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithm
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
Examination duration and	90 minutes
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia
	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 Biomecha
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha
	Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys
	Engineering: Elective Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Ele
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst
	Elective 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
	Engineering Science: 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 Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine Sciences: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process 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	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 		
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 		

Course L0418: Numerical Ma	irse 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
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	NN			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory an	d electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calc	ulations for design, modeling, simulation ar	nd optimization of n	mechatronic systen
Skills	Students are able to apply modern algorithms f	or modeling of mechatronic systems. They	can identify simula	ate and design sim
JKIIIS	systems and implement those in laboratory con		can lacitary, simula	ace und design silli
	systems and implement close in laboratory con			
Personal Competence				
Social Competence	Students are able to work goal-oriented in smal	I mixed groups and present results to targe	t groups.	
Autonomy	Students are able to recognize and improve knowledge deficits independently.			
	With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Mechanical Er	ngineering, Focus M	lechatronics: Elect
Following Curricula	Compulsory			
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanica	al Engineering, Fo	cus Aircraft Syste
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qualificati	on: Compulsory		
	General Engineering Science (English program,	7 semester): Specialisation Mechanical En	gineering, Focus Tl	heoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (English progra	m, 7 semester): Specialisation Mechanica	al Engineering, Foo	cus Aircraft Syste
	Engineering: Elective Compulsory			
	General Engineering Science (English program	, 7 semester): Specialisation Mechanical Er	igineering, Focus M	lechatronics: Elect
	Compulsory			
	Mechanical Engineering: Specialisation Theoret	ical Mechanical Engineering: Elective Comp	ulsory	
	Mechanical Engineering: Specialisation Aircraft		-	
	Mechanical Engineering: Specialisation Aircraft			
	Mechanical Engineering: Specialisation Mechatr			
	Mechanical Engineering: Specialisation Mechatr			
	Mechatronics: Core Qualification: Compulsory	· · · · · · · · · · · · · · · · · · ·		
	Mechatronics: Core Qualification: Compulsory			

Course 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	NN	
Language	DE	
Cycle	WiSe	
Content	Mechatronic Design	
	Modeling	
	Iodel 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	NN		
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		

Lecturer	NN
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0599: Integ	rated Product I	Development and	d Lightweigh	t Design		
Courses						
Title				Тур	Hrs/wk	СР
CAE-Team Project (L0271)				Project-/problem-based Learning	2	2
Development of Lightweight Design	n Products (L0270)			Lecture	2	2
Integrated Product Development I ((L0269)			Lecture	2	2
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
	Advanced Knowledge	about engineering desi	gn:			
Knowledge	Fundamentals of Mec	hanical Engineering Des	ign			
	Mechanical Engineeri	ng: Design				
	Advanced Mechanical					
Educational Objectives	After taking part succ	essfully, students have	reached the followi	ng learning results		
Professional Competence						
Knowledge	After completing the	module, students are ca	pable of:			
	 explaining the 	functional principle of 3	D-CAD-Systems, PD	M- and FEM-Systems		
				the product development proces	S	
Skills						
	After completing the	module, students are ab	le to:			
	 evaluate differ 	ent CAD- and PDM-Sys	tems with regards	to the desired requirements su	ich as classific	ation schemes and
	product structu	ıring				
	 design an exer 	nplary product using CA	D-,PDM- and/or FEN	1-Systems with shared workload		
Personal Competence						
Social Competence	After completing the	module, students are ab	le to:			
	 To develop a p 	roiect plan and allocate	work appropriate w	ork packages in the framework	of aroup discus	ssions
		results as a team for in			<u>5</u> p	
Autonomy	Students are capable	of:				
	 independently 	adapt to a CAE-Tool and	l complete a given	practical task with it		
		· · · · · · · · · · · · · · · · · · ·				
Workload in Hours	Independent Study Ti	me 96, Study Time in Le	ecture 84			
Credit points						
Course achievement		Form	Description	pickt inkl. Vortrag und Ausarboiti	ing	
	Yes 20 %	Subject theoretical practical work	andCAE-reampro	ojekt inkl. Vortrag und Ausarbeitu	ing	
Examination	Written exam	practical work				
Examination duration and	4					
scale						
Assignment for the		Science (German proc	Iram. 7 semester)	: Specialisation Mechanical End	ineerina. Focu	is Aircraft Systems
Following Curricula	5 5		,,,			
5			am, 7 semester): S	pecialisation Mechanical Engine	ering, Focus Pr	oduct Development
	and Production: Comp	oulsory				
	Engineering Science:	Specialisation Mechanic	al Engineering: Ele	ctive Compulsory		
	General Engineering	Science (English prog	ram, 7 semester):	Specialisation Mechanical Eng	ineering, Focu	s Aircraft Systems
	Engineering: Compuls	sory				
	General Engineering	Science (English progra	m, 7 semester): S	pecialisation Mechanical Enginee	ering, Focus Pr	oduct Development
	and Production: Comp	oulsory				
				ecialisation Mechanical Engineeri	ng: Elective Co	mpulsory
	-			d Production: Compulsory		
	-	ng: Specialisation Aircra				
	Product Development	, Materials and Producti	on: Technical Comp	plementary Course Core Studies:	Elective Comp	ulsory

Course L0271: CAE-Team Pro	ject
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	 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	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 Pr	oduct Development l		
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 M0865: Funda	mentals of Production and	Quality Management		
Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L	925)	Lecture	2	3
Quality Management (L0926)		Lecture	2	3
Module Responsible	Prof. Hermann Lödding			
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 explain the content	ts of the lecture of the module.		
Skills	Students are able to apply the methods and models in the module to industrial problems.			
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Tin	ne 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	program, 7 semester): Specialisation Mechan	nical Engineering, Foc	us Aircraft Systems
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German	program, 7 semester): Specialisation Mechanica	l Engineering, Focus P	Product Development
	and Production: Compulsory			
	Engineering Science: Core Qualification:			
		rogram, 7 semester): Specialisation Mechanical E		ompulsory
		ogram, 7 semester): Core Qualification: Comput	-	
		oduction Management and Processes: Compulso	ry	
	Logistics and Mobility: Specialisation En			
	Mechanical Engineering: Core Qualificat			
	Engineering and Management - Major in	Logistics and Mobility: Specialisation Production	n Management and Pro	cesses: Compulsory

Course L0925: Production Pr	ocess Organization		
Тур	Lecture		
Hrs/wk	2		
CP	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		
	Procurement		
	Manufacturing		
	(F) Production planning and control (PPC)		
	(G) Distribution		
	(H) Cooperation		
Literature	Wiendahl, HP.: Betriebsorganisation für Ingenieure		
	Vorlesungsskript		

Course L0926: Quality Manag	jement
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

Module M0767: Aeror	autical Systems				
Module M0707: Aeror	lautical Systems				
Courses					
Title		Тур	Hrs/wl	k CP	
Fundamentals of Aircraft Systems (L0741)	Lecture	2	2	
Fundamentals of Aircraft Systems (L0742)	Recitation Section	n (small) 1	1	
Air Transportation Systems (L0591	1	Lecture	2	2	
Air Transportation Systems (L0816		Recitation Section	n (large) 1	1	
Module Responsible	Prof. Frank Thielecke				
Admission Requirements	None				
Recommended Previous	Basics of mathematics, mechanics and the	ermodynamics			
Knowledge					
Educational Objectives	After taking part successfully, students ha	ve reached the following learning result	S		
Professional Competence					
Knowledge	Students get a basic understanding of th	e structure and design of an aircraft,	as well as an overview	of the systems inside a	
	aircraft. In addition, a basic knowledge of	the relationchips, the key parameters,	roles and ways of workir	ng in different subsyster	
	in the air transport is acquired.				
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and thei				
	technical system implementation. In additi				
	the air transportation system in the context of the overall system.				
Personal Competence		· · · · · · · · · · · · · · · · · · ·			
	Students are made aware of interdisciplina	ary communication in groups.			
	Students are able to independently anal		eir technical implement	tation as well as to thi	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	system oriented.				
Workload in Hours	Independent Study Time 96, Study Time ir	Lecture 84			
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	150 min				
scale					
Assignment for the	General Engineering Science (German p	rogram, 7 semester); Specialisation	Mechanical Engineering	. Focus Aircraft Syster	
-	Engineering: Compulsory			,,,.,	
3	General Engineering Science (English p	rogram, 7 semester); Specialisation I	Aechanical Engineering	. Focus Aircraft Syster	
	Engineering: Compulsory			,	
	Logistics and Mobility: Specialisation Logis	tics and Mobility: Elective Compulsory			
	Logistics and Mobility: Specialisation Traffi		ulsory		
	Mechanical Engineering: Specialisation Ham				
	Engineering and Management - Major in Lo			s: Elective Compulsory	
		pristics and Mobility, specialisation fra	ne rialilling and system	is. Liective 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
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0591: Air Transporta	ation Systems
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	SoSe
Content	 Air transport as part of the global transportation system Legal basis of air transportation Safety and security aspects Aircraft basics The role of the aircraft amnufacturer The role of the aircraft operator Airport operation The principles of air traffic management Environmental aspects of air transportation
Literature	 V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 J.P. Clark: "Buying the Big Jets", ISBN 9781317170341, Taylor & Francis, 2017 Mike Hirst: The Air Transport System, AIAA, 2008 D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN 0-07-003077-4 P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8 H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0

Course L0816: Air Transportation Systems	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Focus Materials in Engineering Sciences

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

Module M0597: Adva	nced Mechanical Engineering Desig	jn		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (L0264)	Lecture	2	2
Advanced Mechanical Engineering	Design II (L0265)	Recitation Section (large)	2	1
Advanced Mechanical Engineering	Design I (L0262)	Lecture	2	2
Advanced Mechanical Engineering	Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Fundamentals of Mechanical Engineering De Mechanics 	esign		
	Fundamentals of Materials Science			
	Production Engineering			
	• Houdedon Engineering			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	After passing the module, students are able to:			
	explain complex working principles and function			
	 explain requirements, selection criteria, app indicate the background of dimensioning cal 		of complex machi	ne elements,
	 Indicate the background of dimensioning call 	iculations.		
Skills	After passing the module, students are able to:			
	- eccentrich dimensioning coloulations of cou	and machine alements		
	accomplish dimensioning calculations of cov		huing altilla)	
	 transfer knowledge learned in the module to recognize the content of technical drawings 		iving skills),	
	 recognize the content of technical drawings evaluate complex designs, technically. 	and schematic sketches,		
	• evaluate complex designs, technically.			
Personal Competence				
Social Competence				
	 Students are able to discuss technical inform 	nation in the lecture supported by activation	ng methods.	
Autonomy				
	Students are able to independently deepen			
	Students are able to acquire additional know	owledge and to recapitulate poorly under	stood 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	semester): Specialisation Mechanical Engi	neering: Compuls	ory
	General Engineering Science (German program			
	Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory			
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, For	us Aircraft Systen
	Engineering: Compulsory			
	General Engineering Science (German program	n, 7 semester): Specialisation Mechani	cal Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program	, 7 semester): Specialisation Mechanic	al Engineering,	Focus Mechatronic
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Eng	Jineering, Focus P	Product Developme
	and Production: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechanic
	Engineering: Compulsory			
	Energy Systems: Technical Complementary Course			
	Engineering Science: Specialisation Mechanical Eng			
	General Engineering Science (English program, 7 s			
	General Engineering Science (English program,	/ semester): Specialisation Mechanica	॥ Engineering, F	ocus Biomechanic
	Compulsory		Fasiana i F	
	General Engineering Science (English program,	/ semester): specialisation Mechanical	Engineering, Foc	us Energy System
	Compulsory	7 semester): Specialisation Mechanical	Engineering For	us Aircraft Suctor
	General Engineering Science (English program, Engineering: Compulsory	, semestery, specialisation Mechanical	Ligineening, FOC	us Anciait Systen
		omostor), Specialization Machanical Engin	eering Feering Me	
				terials in Engineerin
	General Engineering Science (English program, 7 s	emester). Specialisation Mechanical Engli	ieening, Focus Ma	terials in Engineerir

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

	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
	• Elements of hubbles
	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.
	 Konstruktionslehre, Falli, G., Beliz, 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
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

	Lastura
Тур	
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	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, 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, aktue
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bächer 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				
Title		Тур	Hrs/wk	СР
Fundamentals of Mechanical Propert	ties of Materials (L1090)	Lecture	2	3
Welding Technology (L1123)	Lecture 3 3			3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science			
Knowledge				
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that	at are responsible for the mechanical behav	iour of metals. They acq	uire basic knowleg
	in modelling of the materials behaviour. Fu	urthermore, the students learn about the be	haviour of metals under	r static and dynan
	loads. The students get to know the most	important welding technologies and the co	orresponding systems. T	They learn about t
	influence of welding on the materials and c	lesign.		
Chille	The students know the masherical prope	which of matche and the underlying princip	les They are able to m	ana tha influenc
		erties of metals and the underlying princip	les. They are able to h	ame the innuenc
	factors on the welding behaviour of steel m	laterials.		
	The students are able to select between al	loys according to the desired mechaincal pr	operties and welability.	They can distingu
	between different welding techniques and select the suitable technique and system components for a defined application.		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 i	n Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
	General Engineering Science (German	program, 7 semester): Specialisation Me	echanical Engineering,	Focus Materials
Assignment for the	Engineering Sciences: Compulsory		5 5.	
5			Engineering Focus Mat	orials in Engineer
Following Curricula	General Engineering Science (English prog	ram, 7 semester): Specialisation Mechanica	i Liigineenng, Locus Mai	
Following Curricula	General Engineering Science (English prog Sciences: Compulsory	ram, 7 semester): Specialisation Mechanica	r Engineering, rocus Mai	Lendis in Engineer
Following Curricula	5 5 7 5	ram, 7 semester): Specialisation Mechanica	Lingineering, rocus Ma	
Following Curricula	5 5 7 5	ram, 7 semester): Specialisation Mechanica		

Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Norbert Huber	
Language	DE	
Cycle	Se	
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)	
	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.

Courses				
Title		Тур	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	None			
Recommended Previous	 Mathematik I + II for Engineering Students (g) 	erman or english) or Analysis & Linear Alg	rebra I + II for Te	chnomathematic
Knowledge	 basic MATLAB/Python knowledge 			ennomathematik
-	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	Students are able to			
	 name numerical methods for interpolation, in 	ntegration, least squares problems, eigenv	alue problems, r	ionlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the nume 	erical methods,		
	 explain aspects for the practical execution of 	numerical methods with respect to compo	utational and stor	age complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical me 	ethods using MATLAB/Python		
	 justify the convergence behaviour of numeric 		nd solution algori	thm
	 select and execute a suitable solution approx 		na seración argen	,
Personal Competence				
Social Competence	Students are able to			
	 work together in heterogeneously composed 	teams (i.e., teams from different study pr	ograms and bac	around knowled
	explain theoretical foundations and support e			
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 nece 		· · · · , ·	
Workload in Hours		2 56		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 minutes			
scale				
	General Engineering Science (German program, 7 s			
Following Curricula	General Engineering Science (German program	, 7 semester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 s			
	General Engineering Science (German program, Compulsory	/ semester). Specialisation Mechanica	i Engineering, r	ocus biomecna
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical Engir	eering Focus Th	eoretical Mecha
	Engineering: Compulsory	Enclose , openandation mechanical Engli		Longeneration Meerid
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineerina. Foc	us Aircraft Svst
	Engineering: Elective Compulsory	, permanent i containeur	J	
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical Engli	neering, Focus M	echatronics: Elec
			-	
	Compulsory			
	Compulsory General Engineering Science (German program,		Engineering, Foc	
			Engineering, Foc	
	General Engineering Science (German program,	7 semester): Specialisation Mechanical I		
	General Engineering Science (German program, Elective Compulsory	7 semester): Specialisation Mechanical i Bioprocess Engineering: Elective Compulso		
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory	ory	
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory	ory	
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General E Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso	ory	
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General E Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory	ory	
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y	ory	
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y y meester): Core Qualification: Compulsory	nry pry	
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science	ory ory : Compulsory	us Energy Syste
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science	ory ory : Compulsory	us Energy Syste
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory ad Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical	ory ory : Compulsory Engineering, F	us Energy Syste ocus Biomecha
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory ad Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical	ory ory : Compulsory Engineering, F	us Energy Syste ocus Biomecha
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	ory ory : Compulsory Engineering, F eering, Focus Mat	us Energy Syste ocus Biomecha erials in Enginee
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	ory ory : Compulsory Engineering, F eering, Focus Mat	us Energy Syste ocus Biomecha erials in Enginee
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine	ering, Focus Th	us Energy Syste ocus Biomecha erials in Enginee eoretical Mecha
	General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine emester): Specialisation Biomedical Engine	ering: Compulsory	us Energy Syste ocus Biomecha erials in Enginee eoretical Mecha Y

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I	
Тур	Lecture	
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
Language	EN	
Cycle	WiSe	
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 	
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 	

Course L0418: Numerical Ma	Irse 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						
ïtle		Тур	Hrs/wk	СР		
Companion Lecture for Materials S	cience Laboratory (L1088)	Lecture	2	2		
Naterial Science Laboratory (L123	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	e reached the following learning results				
Professional Competence						
Knowledge	Students are able to give a summary of	the technical details of experiments in the	area of materials sc	iences and illust		
	respective relationships. They are capable	of describing and communicating relevant p	problems and questio	ns using appropr		
	technical language. They can explain the ty	pical process of solving practical problems ar	nd present related res	ults.		
CL:!!!-	The students can be after the information of					
SKIIIS	The students can transfer their fundament					
	identity and overcome typical problems dur	ing the realization of experiments in the cont	ext of material scienc	es.		
Personal Competence						
Social Competence	Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are at					
	to effectively present and explain their resu	Its alone or in groups in front of a qualified au	udience.			
Autonomy	Students are capable of solving problems in			y are able to fill g		
		he literature and other sources provided by the	le supervisor.			
	Independent Study Time 96, Study Time in	Lecture 84				
Credit points						
Course achievement						
	Subject theoretical and practical work					
Examination duration and	Test reports on the respective tests and onl	ine learning modules with integrated success	control			
scale						
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Mecl	hanical Engineering,	Focus Materials		
Following Curricula	Engineering Sciences: Compulsory					
	General Engineering Science (German prog	ram, 7 semester): Specialisation Mechanical	Engineering, Focus F	Product Developn		
	and Production: Elective Compulsory					
	General Engineering Science (English progra	am, 7 semester): Specialisation Mechanical E	ngineering, Focus Ma	terials in Enginee		
	Sciences: Compulsory					
	Mechanical Engineering: Specialisation Prod	uct Development and Production: Compulsor	у			
	Mechanical Engineering: Specialisation Mate	erials in Engineering Sciences: Compulsory				
	Product Development, Materials and Product	tion: Technical Complementary Course Core	Studies: Elective Com	pulsory		

Тур	Lecture				
Hrs/wk	2				
СР	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	of. Kaline Pagnan Furlan				
Language	DE				
Cycle	WiSe				
Content	Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be				
	ddressed 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)				
	B. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)				
	4. tensile test (elastic properties of solids)				
	5. Identificiation of polymers (polymer physics)				
	6. fiber-reinforced polymers (physical principles of composite materials)				
	7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)				
	8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)				
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011)				
	William D. Callister, Materials Science and Technology, Wiley & Sons, Inc. (2007)				

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

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 rea	ched 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-leprogramming 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 Institution of the compaction of the CDU, prioritical of pageing data, paint to p					
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 collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluat 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 alor	e or in a group and to present the results ac	cordinaly			
Social Competence	Students are able to solve similar problems alon	e of in a group and to present the results ac	.corunigiy.			
Autonomy	Students are able to acquire new knowledge fro	m specific literature and to associate this kn	owledge with othe	r classes.		
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56				
Credit points						
Course achievement		Description				
	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 semester): Specialisation Computer Scien	ce: Compulsory			
Following Curricula						
	General Engineering Science (German program,					
	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanic	cal Engineering, I	ocus Mechatroni		
	Compulsory	- 7	Fasia ania a Fas	Alara the Country		
	General Engineering Science (German progra	m, / semester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syste		
	Engineering: Compulsory					
	General Engineering Science (German program	7 semester): Specialisation Mechanical End	iineerina. Focus Th	eoretical Mechani		
	General Engineering Science (German program, Engineering: Compulsory	7 semester): Specialisation Mechanical Eng	jineering, Focus Th	eoretical Mechani		
	General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German progr					
	Engineering: Compulsory					
	Engineering: Compulsory General Engineering Science (German progr	am, 7 semester): Specialisation Mechan	ical Engineering,	Focus Materials		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory	am, 7 semester): Specialisation Mechan	ical Engineering,	Focus Materials		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En	ical Engineering, gineering, Focus P	Focus Materials		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En n, 7 semester): Specialisation Mechanical	ical Engineering, gineering, Focus P Engineering, Foc	Focus Materials roduct Developme us Energy System		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En n, 7 semester): Specialisation Mechanical	ical Engineering, gineering, Focus P Engineering, Foc	Focus Materials roduct Developm us Energy Syster		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanica 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engi 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine	ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory	Focus Materials roduct Developm us Energy Syster ocus Biomechani		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program,	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engi 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo	ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory	Focus Materials roduct Developm us Energy Syster ocus Biomechani		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program,	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engi 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo	ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory	Focus Materials roduct Developm us Energy Syster ocus Biomechani		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsor	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engin 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo	ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory	Focus Materials roduct Developm us Energy Syster ocus Biomechan yry ry		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsor Data Science: Core Qualification: Elective Comp Electrical Engineering: Core Qualification: Compu General Engineering Science (English program,	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engin 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo amy Jasory Jasory Jasory Specialisation Civil Engineering	ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew :: Compulsory	Focus Materials roduct Developm us Energy Syster ocus Biomechan my ry ry able Energy: Elect		
	Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsor Data Science: Core Qualification: Elective Comp Electrical Engineering: Core Qualification: Compu	am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engin 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo amy Jasory Jasory Jasory Specialisation Civil Engineering	ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew :: Compulsory	Focus Materials roduct Developm us Energy Syster ocus Biomechan my ry ry able Energy: Elec		

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
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	ependent Study Time 78, Study Time in Lecture 42		
Lecturer	of. Heiko Falk		
Language	DE/EN		
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	ourse L0324: Computer Engineering			
Тур	Recitation Section (small)			
Hrs/wk				
CP	2			
Workload in Hours	ependent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Heiko Falk			
Language	DE/EN			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Courses					
Title			Тур	Hrs/wk	СР
Materials and Process Modeling (L2	2862)		Lecture	3	3
Materials Selection and Processing	(L2861)		Lecture	3	3
Module Responsible	Prof. Norbert Huber				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part su	ccessfully, students ha	ve reached the following learning results		
Professional Competence					
	are decisive for the applicability and economic efficiency. Metallic materials are in the foreground. Ceramics and polymers are covered in the sense of a broad range of available materials. In parallel to the material-technological consideration, the modeling of material behavior by means of phenomenological mat laws for plasticity under monotonic and cyclic loading is worked out. In addition to the evaluation of component behavior, plast also plays a major role in manufacturing processes and thus provides the basis for process simulation. Process models simulation methods for selected manufacturing processes, such as rolling or forming, are presented for this topic area.				
Skills					
Personal Competence					
Social Competence					
Autonomy	,				
Workload in Hours	Independent Study	Time 96, Study Time ir	Lecture 84		
Credit points	6				
Course achievement	Compulsory Bonus Yes 20 %	Form Excercises	Description Wir stellen Übungsaufgaben (ÜA), den wöchentlichen Übungen vorg bis zu 20% bei der Prüfung berück	estellt werden. Diese kör	
	Written exam				
Examination					
Examination Examination duration and	120 min				
Examination duration and		ng Science (German	program, 7 semester): Specialisation M	lechanical Engineering,	Focus Materials
Examination duration and scale	General Engineerir	-	program, 7 semester): Specialisation M	lechanical Engineering,	Focus Materials
Examination duration and scale Assignment for the	General Engineerin Engineering Science	es: Compulsory	program, 7 semester): Specialisation M terials in Engineering Sciences: Compulsory		Focus Materials
Examination duration and scale Assignment for the Following Curricula	General Engineerir Engineering Science Mechanical Enginee	es: Compulsory ering: Specialisation Ma			Focus Materials
Examination duration and scale Assignment for the Following Curricula Course L2862: Materials and	General Engineerir Engineering Science Mechanical Enginee	es: Compulsory ering: Specialisation Ma			Focus Materials
Examination duration and scale Assignment for the Following Curricula Course L2862: Materials and	General Engineerin Engineering Science Mechanical Engineer Process Modeling Lecture	es: Compulsory ering: Specialisation Ma			Focus Materials

СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Norbert Huber
Language	EN
Cycle	SoSe
Content	 Relevance of plasticity in materials processing and operation Fundamentals of plasticity in metals and alloys Modellierung von Materialverhalten Plasticity in cyclic loading Rate dependency, recristallization Rolling, forming, and solid state joining processes Residual stress design
Literature	 Hull and Bacon: Introduction to Dislocations (1984) G. Gottstein: Physik. Grundlagen der Materialk. (2001) P. Haupt: Cont. Mechanics and Theory of Materials (2002) N. Huber: Vorlesungsskript "Grundlagen der mechanischen Eigenschaften von Werkstoffen", TUHH

Course L2861: Materials Sele	ection and Processing			
Тур	Lecture			
Hrs/wk	3			
CP				
Workload in Hours	lependent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Kaline Pagnan Furlan			
Language	EN			
Cycle	SoSe			
Content	 Introduction Overview of fabrication processes Shape considerations: macrostructural aspects Material properties: microstructural aspects Materials engineering: microstructure, shape and processing relation Materials engineering: function and costs relation 			
Literature	 M.F. Ashby, Materials Selection in Mechanical Design, 4thedition, Butterworth-Heinemann(2011) W.F. Gale and T.C. Totemeier, Smithells Metals Reference Book, 8thedition, Butterworth-Heinemann(2004) J. Beddoes and M. Bibby, Principles of Metal Manufacturing Processes, Butterworth-Heinemann(1999) 			

Fieldie Filosof Ellina	nced Fundamentals of Materia					
Courses						
Title			Тур	Hrs/wk	СР	
Enhanced Fundamentals: Ceramics			Lecture	2	2	
Enhanced Fundamentals: Ceramics	-		Recitation Section (large)	1	1	
	Enhanced Fundamentals: Metals (L1086) Lecture 2 3					
Module Responsible						
Admission Requirements	None					
	Module "Fundamentals of Materials Science					
Knowledge	Module "Materials Science Laboratory"					
	·····,					
	Module "Advanced Materials"					
Educational Objectives	After taking part successfully, students have	e reached the following	g learning results			
Professional Competence						
	The students are able to give an enhanced	overview over the follo	wing topics			
	in metals, polymers and ceramics: Atomic			fects , electrical	and mass transpor	
	microstructure and phase diagrams. They a					
Skills	The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.					
				· · · · · · · · · · · · · · · · · · ·		
Personal Competence						
Social Competence						
Autonomy	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should					
	be able to critally evaluate the profoundness of their knowledge.					
		n Lecture 70				
Credit points						
Course achievement						
Examination	Written exam					
Examination duration and	180 min					
scale						
Assignment for the	General Engineering Science (German p	orogram, 7 semester): Specialisation Mechani	cal Engineering,	Focus Materials	
Following Curricula	Engineering Sciences: Compulsory					
	Data Science: Core Qualification: Elective Co					
	General Engineering Science (English progr	am, 7 semester): Spec	ialisation Mechanical Engin	eering, Focus Ma	terials in Engineerir	
	Sciences: Compulsory					
	General Engineering Science (English prog	ram, 7 semester): Spe	ecialisation Mechanical Eng	jineering, Focus F	Product Developme	
	and Production: Compulsory					
	Mechanical Engineering: Specialisation Mate					
	Technomathematics: Specialisation III. Engi	neering Science: Elect	ive Compulsory			

Course L1233: Enhanced Fun	idamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	DE/EN
Cycle	SoSe
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 Bayer-Prozess zur AlzOs-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
	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	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

se L1086: Enhanced Fur	Idamentals: Metals		
Тур	Lecture		
Hrs/wk			
CP	3		
Workload in Hours	ndependent Study Time 62, Study Time in Lecture 28		
Lecturer	rof. Jörg Weißmüller		
Language			
Cycle			
Content	Advanced understanding of metals:		
	Physical materials properties		
	Materials behaviour - elastic, thermal, electrical Superelasticity and change memory effect		
	 Superelasticity and shape memory effect Fundamentals of electrical conductivity in metals and semiconductors 		
	o Superconductivity		
	Chemical (or "dry") corrosion		
	Driving forces and mechanisms Bassivation		
	o Passivation o Growth laws		
	Introduction to electrochemistry		
	o Electrolytes o lons		
	o Solvatation		
	o Dissolution and deposition of metals		
	o Galvanic cells and cell voltage		
	o Galvanic ceris and ceri voltage		
	o Nernst equation		
	o Polarizable electrodes		
	Constitute and provides apositive processor		
	 Capacitive and pseudocapacitive processes Capacitive currents and Faraday currents 		
	Electrochemical (or "wet") corrosion and corrosion protection		
	o Basic observations		
	o Galvanic corrosion		
	o Protection against galvanic corrosion		
	o Stainless steel		
	o sacrificial anodes		
	o Passivation and Pourbaix diagrams		
	o Corrosion through gas reduction		
	o Crevice corrosion		
	o Stress corrosion cracking		
	o Alloy corrosion and nanoporous metals		
	Electrochemical energy storage		
	o How a battery works		
	o Lead accumulators		
	o Alkaline batteries		
	o Nickel-metal hydride accumulators		
	o Flux batteries		
	o Lithium-ion accumulators		
	o Electrolytic and super capacitors		
	o Fuel cells		
	Materials for hydrogen storage		
	o Storage strategies		
	 Requirements for storage materials 		
	o State of the art		
	Magnetism and magnetic materials		
	o Phenomenology: magnetic field and magnetization		
	 Para-, ferro-, antiferromagnets; Curie transition 		
	 Magnetism at the atomic scale; exchange coupling 		
	o Magnetization isotherms, domains		
	o Measurement methods		

- o Measurement methods
- o Magnetocrystalline anisotropy and domain walls
- o Hard magnetic materials and their applications

	o Soft magnetic materials and their applications
Literature	- Vorlesungsskript
	- W.D. Callister, "Materialwissenschaften und Werkstofftechnik ", Wiley-VCH 2012
	- Carl H. Hamann, Wolf Vielstich, "Elektrochemie", Wiley-VCH; 4. Auflage 2005
	- Kurzweil, Dietlmeier, "Elektrochemische Speicher" Springer Vieweg (2015)
	(eBook: https://link.springer.com/book/10.1007/978-3-658-10900-4)
	- B. D. Cullity, C.D. Graham, "Introduction to magnetic materials", John Wiley & Sons, 2011
	- D. Jiles, "Introduction to magnetism and magnetic materials", CRC press, 2015

Module M0934: Advai	and Matarials			
Module M0954: Adval				
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Characterizatio	n (L1087)	Lecture	2	2
Advanced Materials Design (L1091)		Lecture	2	2
Advanced Materials Design (L1092)		Recitation Section (large)	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 hav	ve reached the following learning results		
Professional Competence				
Knowledge	The students will be able to explain the properties of advanced materials along with their applications in technology, in particula metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials.			
Skills	The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview or modern materials science, which enables them to select optimum materials combinations depending on the technical applications.			
Personal Competence Social Competence	The students are able to present solutions to specialists and to develop ideas further.			
Autonomy	The students are able to			
	 assess their own strengths and weak 	knesses.		
	define tasks independently.			
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				
Assignment for the	General Engineering Science (German p	program, 7 semester): Specialisation Mecha	nical Engineering, I	ocus Biomechanio
Following Curricula		·		
	General Engineering Science (German p	program, 7 semester): Specialisation Mech	anical Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	Data Science: Specialisation Materials Scien	nce: Compulsory		
	General Engineering Science (English progr	ram, 7 semester): Specialisation Mechanical En	gineering: Elective C	Compulsory
	Mechanical Engineering: Core Qualification:			

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

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

Ξ

Focus Mechatronics

Module M0597: Adva	nced Mechanical Engineering D	esign		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (L0264)	Lecture	2	2
Advanced Mechanical Engineering	Design II (L0265)	Recitation Section (large)	2	1
Advanced Mechanical Engineering		Lecture	2	2
Advanced Mechanical Engineering	Design I (L0263)	Recitation Section (large)	2	1
Module Responsible	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge		ng Design		
	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence	51 5.	5 5		
	After passing the module, students are able t	0.		
Knowledge	After pussing the module, students are use t			
	explain complex working principles and	d functions of machine elements and of basic e	elements of fluidics,	,
	explain requirements, selection criteria	a, application scenarios and practical examples	of complex maching	ne elements,
	indicate the background of dimensioni	ng calculations.		
Chille	After passing the module, students are able t			
SKIIIS	After passing the module, students are able t	0:		
	accomplish dimensioning calculations	of covered machine elements,		
	• transfer knowledge learned in the mod	lule to new requirements and tasks (problem s	olving skills),	
	 recognize the content of technical draw 	vings and schematic sketches,		
	• evaluate complex designs, technically			
Personal Competence				
Social Competence	 Students are able to discuss technical 	information in the lecture supported by actival	ring methods	
	• Students are use to discuss technical	mornation in the lecture supported by activat	ing methods.	
Autonomy				
		epen their acquired knowledge in exercises.		
		al knowledge and to recapitulate poorly unde	rstood content e.g	. by using the vid
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Le	ecture 112		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120			
scale				
			<u> </u>	
Assignment for the		m, 7 semester): Specialisation Mechanical Eng		-
Following Curricula		gram, 7 semester): Specialisation Mechani	cal Engineering, F	ocus Biomechani
	Compulsory			
		ram, 7 semester): Specialisation Mechanica	Engineering, Foc	us Energy Syster
	Compulsory			
	General Engineering Science (German prog	gram, 7 semester): Specialisation Mechanica	l Engineering, Foc	us Aircraft Syste
	Engineering: Compulsory			
	5 5 1	ogram, 7 semester): Specialisation Mechar	nical Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German pro	gram, 7 semester): Specialisation Mechani	cal Engineering, F	Focus Mechatroni
	Compulsory			
	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical Er	ngineering, Focus P	Product Developme
	and Production: Compulsory			
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical En	gineering, Focus Th	eoretical Mechani
	Engineering: Compulsory			
	Energy Systems: Technical Complementary C	Course Core Studies: Elective Compulsory		
	Engineering Science: Specialisation Mechanic	al Engineering: Compulsory		
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical Engi	neering: Compulso	ry
		gram, 7 semester): Specialisation Mechanic		
	Compulsory	·		
		ram, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syster
	Compulsory	·	J	5, 2,220
		ram, 7 semester): Specialisation Mechanica	l Engineering. Foc	us Aircraft Syste
	La casa ang serence (English prog	,		
	Engineering: Compulsory			
	Engineering: Compulsory General Engineering Science (English program	n. 7 semester): Specialisation Mechanical Eng	neering. Focus Mat	terials in Engineer
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical Eng	ineering, Focus Mat	terials in Engineer
		n, 7 semester): Specialisation Mechanical Eng	ineering, Focus Mat	terials in Engineer

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

C	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:	
C	Compulsory	
C	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development	
a	and Production: Compulsory	
C	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical	
E	Engineering: Compulsory	
Ν	Mechanical Engineering: Core Qualification: Compulsory	
Ν	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.		
	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
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	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, 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, akt
	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	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Circuit Theory (L0566)		Lecture	3	4
Circuit Theory (L0567)		Recitation Section (small)	2	2
Module Responsible	Prof. Alexander Kölpin			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I and II, Mathematics I an	d II		
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the basic method	s for calculating electrical circuits. They kno	w the Fourier ser	ies analysis of line
	networks driven by periodic signals. They kno	w the methods for transient analysis of line	ar networks in tir	me and in frequen
	domain, and they are able to explain the freque	ncy behaviour and the synthesis of passive to	vo-terminal-circui	ts.
Skills	The students are able to calculate currents an			
	periodic signals. They are able to calculate tran			
	respective transient behaviour. They are able	to analyse and to synthesize the frequenc	y behaviour of p	assive two-termin
	circuits.			
Devecuel Competence				
Personal Competence	Students work on eversise tacks in small qui	led groups. They are encouraged to proceed	t and discuss the	ir roculte within t
Social Competence	Students work on exercise tasks in small guid group.	led groups. They are encouraged to presen		er results within t
	group.			
Autonomy	The students are able to find out the required r	methods for solving the given practice proble	ms Possibilities a	re given to test the
Autonomy	knowledge during the lectures continuously			
	educational objectives. They can link their gaine			
	Independent Study Time 110, Study Time in Lee	cture 70		
Credit points				
Course achievement				
	Written exam			
Examination duration and	150 min			
scale	Consul Engineering Colones (Corners areas	and 7 competer). Cresislication Mechanic		Tagua Machatrania
	General Engineering Science (German progr	ani, / semester): specialisation Mechanic	ar Engineering,	rocus mechaironio
Following Curricula	General Engineering Science (German program	7 semester): Specialisation Electrical Engine	erina: Compulsor	1
	Electrical Engineering: Core Qualification: Comp		cring. compuisor	7
	Engineering Science: Specialisation Electrical En	•		
	General Engineering Science (English progra		al Engineering.	Focus Mechatronio
	Compulsory		557	
	Computational Science and Engineering: Specia	lisation II. Mathematics & Engineering Scienc	e: Elective Compu	Ilsory
	Mechatronics: Core Qualification: Compulsory			-
	Technomathematics: Specialisation III. Engineer	ing 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	urse 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, Dr. Fabian Lurz		
Language	DE		
Cycle	WiSe		
Content	see interlocking course		
Literature	siehe korrespondierende Lehrveranstaltung		
	see interlocking course		

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	NN				
Admission Requirements	None				
Recommended Previous	Fundatmentals of mechanics, control theory an	d electrical engineering			
Knowledge					
Educational Objectives	After taking part successfully, students have re-	ached the following learning results			
Professional Competence					
Knowledge	Students are able to describe methods and calc	ulations for design, modeling, simulation ar	nd optimization of n	mechatronic systen	
Skills	Students are able to apply modern algorithms f	or modeling of mechatronic systems. They	can identify simula	ate and design sim	
JKIIIS	systems and implement those in laboratory con		can lacitary, simula	ace und design silli	
	systems and implement close in laboratory con				
Personal Competence					
Social Competence	Students are able to work goal-oriented in smal	I mixed groups and present results to targe	t groups.		
Autonomy	Students are able to recognize and improve kno	Students are able to recognize and improve knowledge deficits independently.			
	With instructor assistance, students are able to	evaluate their own knowledge level and de	fine a further cours	e of study.	
Workload in Hours	Independent Study Time 124, Study Time in Le	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): Specialisation Mechanical Er	ngineering, Focus M	lechatronics: Elect	
Following Curricula	Compulsory				
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanica	al Engineering, Fo	cus Aircraft Syste	
	Engineering: Elective Compulsory				
	Digital Mechanical Engineering: Core Qualificati	on: Compulsory			
	General Engineering Science (English program,	7 semester): Specialisation Mechanical En	gineering, Focus Tl	heoretical Mechani	
	Engineering: Elective Compulsory				
	General Engineering Science (English progra	m, 7 semester): Specialisation Mechanica	al Engineering, Foo	cus Aircraft Syste	
	Engineering: Elective Compulsory				
	General Engineering Science (English program	, 7 semester): Specialisation Mechanical Er	igineering, Focus M	lechatronics: Elect	
	Compulsory				
	Mechanical Engineering: Specialisation Theoret	ical Mechanical Engineering: Elective Comp	ulsory		
	Mechanical Engineering: Specialisation Aircraft		-		
	Mechanical Engineering: Specialisation Aircraft				
	Mechanical Engineering: Specialisation Mechatr				
	Mechanical Engineering: Specialisation Mechatr				
	Mechatronics: Core Qualification: Compulsory	· · · · · · · · · · · · · · · · · · ·			
	Mechatronics: Core Qualification: Compulsory				

Course 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	NN	
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	ourse L1823: Simulation and Design of Mechatronic Systems		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	NN		
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		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		

Lecturer	NN
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0730: Comp					
Courses					
Title			Тур	Hrs/wk	СР
Computer Engineering (L0321) Computer Engineering (L0324)			Lecture Recitation Section (small)	3 1	4
Module Responsible	Prof Heiko Falk		Nectation Section (small)	±	Z
Admission Requirements	None				
	Basic knowledge in electrical	engineering			
Knowledge		5 5			
Educational Objectives	After taking part successfully,	students have reached the	following learning results		
Professional Competence					
Knowledge	programming down to gates.		ality of computing systems. It con lowing topics:	vers the layers fron	n the assembly-le
	 Sequential logic: Flip-flu Technological foundation Computer arithmetic: In Basics of computer arcs 	ps, automata, systematic ł ns teger addition, subtraction itecture: Programming mo	, multiplication and division dels, MIPS single-cycle architectur		works
	-	archies, SRAM, DRAM, cach ne perspective of the CPU,	nes principles of passing data, point-to	o-point connections,	busses
Skills	composition of computer syst collection of few and simple of today's computing systems - 1 After successful completion of system and the software exect on the hardware-centric abstr	ems. The students can ana omponents. They are able rom gates and circuits up t f the module, the student uted on it. In particular, th action layers from the asse	ect's perspective, i.e., they identif yze, how highly specific and indiv to distinguish between and to ex o complete processors. s are able to judge the interdepe ey shall understand the conseque embly language down to gates. The entire system's performance and t	idual computers car cplain the different endencies between ences that the exect is way, they will be	n be built based of abstraction layer a physical compo- ution of software enabled to evalu
	the impact that these low uss		indre system s performance and e		prioris.
Personal Competence					
Social Competence	Students are able to solve sim	ilar problems alone or in a	group and to present the results a	iccordingly.	
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	Descri	otion		
F	Yes 10 % Excerc	ses			
	written exam	and labe			
Examination	00 minutes, contents of cours				
Examination duration and	90 minutes, contents of cours				
Examination duration and scale		German program, 7 semes	ter): Specialisation Computer Scie	nce: Compulsory	
Examination duration and scale Assignment for the	General Engineering Science		ter): Specialisation Computer Scie ter): Specialisation Civil Engineeri		
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (German program, 7 semes	ter): Specialisation Computer Scie ter): Specialisation Civil Engineeri ter): Specialisation Process Engine	ng: Compulsory	
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri	ng: Compulsory eering: Compulsory	Focus Mechatron
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine	ng: Compulsory eering: Compulsory	Focus Mechatron
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science Compulsory General Engineering Science	German program, 7 semes German program, 7 semes (German program, 7 s	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine	ng: Compulsory eering: Compulsory ical Engineering, I	
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science Compulsory General Engineering Science Engineering: Compulsory	German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica	ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Foc	us Aircraft Syste
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science Compulsory General Engineering Science Engineering: Compulsory General Engineering Science	German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan	ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Foc	us Aircraft Syste
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science (Engineering: Compulsory	German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 sen German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En	ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Focus Th igineering, Focus Th	us Aircraft Syste
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science (Engineering: Compulsory	German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 semes German program, 7 semes e (German program, 7 s	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica	ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Focus Th igineering, Focus Th	us Aircraft Syste
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Science) (Engine	German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser German program, 7 semes e (German program, 7 s sory	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En	ng: Compulsory eering: Compulsory ical Engineering, F al Engineering, Foc gineering, Focus Th nical Engineering,	us Aircraft Syste neoretical Mechan Focus Materials
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compu General Engineering Science (and Production: Compulsory	German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser German program, 7 semes e (German program, 7 seme sory German program, 7 seme	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mecha ster): Specialisation Mechanical E	ng: Compulsory eering: Compulsory ical Engineering, F al Engineering, Foc gineering, Focus Th nical Engineering, ngineering, Focus P	us Aircraft Syste neoretical Mechan Focus Materials Product Developm
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compu General Engineering Science and Production: Compulsory General Engineering Science (Compulsory Science)	German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 seme	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mecha ster): Specialisation Mechanical E nester): Specialisation Mechanical E	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc	us Aircraft Syste neoretical Mechan Focus Materials Product Developm us Energy Syste
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compu General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory	German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 seme (German program, 7 ser	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc	us Aircraft Syste neoretical Mechan Focus Materials Product Developm us Energy Syste
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compu General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science	German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 sem (German program, 7 ser German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc	us Aircraft Syste neoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 sem (German program, 7 semes German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsor	us Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science (General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes e (German program, 7 seme (German program, 7 seme (German program, 7 seme German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory	eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes e (German program, 7 seme (German program, 7 seme (German program, 7 seme German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Biomedical Engi	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory	eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 seme (German program, 7 seme (German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory	eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General	German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory	eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engineering Science (German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory	eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science) Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science (General	German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 semes German program, 7 semes	ter): Specialisation Civil Engineerin ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanical En ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Mechanica ter): Specialisation Biomedical Engi ter): Specialisation Electrical Engin ter): Specialisation Green Technol	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ical Engineering, Foc gineering: Compulsory gineering: Compulsory ogies, Focus Renew g: Compulsory	eus Aircraft Syste leoretical Mechar Focus Materials Product Developm us Energy Syste Focus Biomechar Ory Y able Energy: Elec
Examination duration and scale Assignment for the	General Engineering Science (General Engineering Science) General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engin	German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 seme (German program, 7 semes German program, 7 semest (cation: Compulsory English program, 7 semest	ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Electrical Engi ter): Specialisation Green Technol	ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Focus P al Engineering, Foc ical Engineering, Foc ical Engineering, Foc gineering: Compulsory gineering: Compulsory ogies, Focus Renew g: Compulsory cal Engineering, F	eoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan ory yry able Energy: Elect

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
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
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE/EN
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	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/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	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	None			
Recommended Previous	 Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Alg	gebra I + II for Te	chnomathematic
Knowledge	basic MATLAB/Python knowledge	,, _,, _	<u> </u>	
-	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowleage	Students are able to			
	 name numerical methods for interpolation, i 	ntegration, least squares problems, eigenv	value problems, r	onlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the num 	erical methods,		
	 explain aspects for the practical execution or 	f numerical methods with respect to comp	utational and sto	rage complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical m 	ethods using MATLAB/Pvthon.		
	 justify the convergence behaviour of numeri 		nd solution algori	ithm,
	 select and execute a suitable solution approx 			
Personal Competence				
Social Competence	Students are able to			
	 work together in heterogeneously composed 	teams (i.e., teams from different study p	rograms and bac	kground knowled
	explain theoretical foundations and support			
Autonomy	Students are capable			
	 to assess whether the supporting theoretical 	and practical excercises are better solved	l individually or ir	ı a team,
	 to assess their individual progess and, if nec 			
	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	90 minutes			
scale				
	General Engineering Science (German program, 7 s			
Following Curricula	General Engineering Science (German program	i, 7 semester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory		e e nimero Como e de	
	General Engineering Science (German program, 7 s			
	General Engineering Science (German program, Compulsory	, v semester). Specialisation Mechanica	i Eligineering, r	ocus biomecnai
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	peering Focus Th	enetical Mecha
	Engineering: Compulsory	semestery, specialisation ricchanical Eligi		Corecicui Mecildi
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering. For	us Aircraft Svst
		, special contraction free and the	J	
	Engineering. Elective Compulsorv			ochotropics, Elo
	Engineering: Elective Compulsory General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	neering, Focus M	echacionics. Elec
		semester): Specialisation Mechanical Engi	neering, Focus M	echacionics. Elec
	General Engineering Science (German program, 7			
	General Engineering Science (German program, 7 Compulsory			
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical I	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulse	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor)	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y	Engineering, Foc	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 so	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y Y emester): Core Qualification: Compulsory	Engineering, Foc ory ory	
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science	Engineering, Foc ory ory :: Compulsory	us Energy Syste
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science	Engineering, Foc ory ory :: Compulsory	us Energy Syste
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical	Engineering, Foc ory ory :: Compulsory I Engineering, F	us Energy Syste
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program)	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical	Engineering, Foc ory ory :: Compulsory I Engineering, F	us Energy Syste
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 sc Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	Engineering, Foc ory :: Compulsory I Engineering, F eering, Focus Mat	us Energy Syste Focus Biomechai terials in Enginee
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine	Engineering, Foc ory :: Compulsory I Engineering, F eering, Focus Mat	us Energy Syste Focus Biomechai terials in Enginee
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective G Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	Engineering, Foc pry cry cry E Compulsory E Engineering, F eering, Focus Mat eeering, Focus Th	us Energy Syste Focus Biomechan terials in Enginee neoretical Mechan
	General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory	7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	Engineering, Foc pry cry cry cry cry compulsory compulsory cering, Focus Mat heering, Focus Th eering: Compulso	us Energy Syste Focus Biomechai terials in Enginee neoretical Mechai

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I		
Тур	Lecture		
Hrs/wk	2		
CP			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne		
Language	EN		
Cycle	WiSe		
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 		
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 		

Course L0418: Numerical Ma	rse 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	CP
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 comp	lexe numbers, integrals, differentials		
Knowledge	Basics of electrical engineering and mech	anical engineering		
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basi	c principles of electric and magnetic fields.		
	They can describe the function of the	standard trucc of clastic mashings and pro	cont the correspond	dina aquationa a
	-	standard types of electric machines and pre- rives they can explain the major parameters of the		
	from the power grid to the driven engine.	ives they can explain the major parameters of th	le energy eniciency	of the whole syste
Skills	Students are able to calculate two-dimen	sional electric and magnetic fields in particular	ferromagnetic circo	uits with air gap. I
	this they apply the usual methods of the c	lesign auf electric machines.		
	They can calulate the operational perform	nance of electric machines from their given cha	aracteristic data and	d selected quantit
		usual equivalent circuits and graphical methods.		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calcul	ate electric and magnatic fields for applications.	They are able to an	nalyse independer
	the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantiti			
	and characteristic curves.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Design of four machines and actuators, re	view of design files		
scale				
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Electrical Engi	neering: Elective Co	mpulsory
Following Curricula	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanica	al Engineering, Foc	us Energy Syster
	Compulsory			
		program, 7 semester): Specialisation Mechan	ical Engineering,	Focus Mechatroni
	Compulsory	gram, 7 semester): Specialisation Mechanical En	aincoring Focus Th	antical Machani
	Engineering: Elective Compulsory	grani, 7 semester). Specialisation Mechanical En	igineering, rocus ri	
	Digital Mechanical Engineering: Core Qual	ification: Compulsory		
	Electrical Engineering: Core Qualification:			
	Energy and Environmental Engineering: C			
	General Engineering Science (English prog	gram, 7 semester): Specialisation Mechanical Eng	ineering: Elective C	ompulsory
	Green Technologies: Energy, Water, Clima	te: Specialisation Energy Technology: Elective Co	ompulsory	
	Logistics and Mobility: Specialisation Engin	neering Science: Elective Compulsory		
	Logistics and Mobility: Specialisation Traff	c Planning and Systems: Elective Compulsory		
		uction Management and Processes: Elective Com	pulsory	
	Mechanical Engineering: Core Qualification			
	Mechatronics: Core Qualification: Compute	•		
	Technomathematics: Specialisation III. En			
	Engineering and Management - Major in L	jineering Science: Elective Compulsory ogistics and Mobility: Specialisation Traffic Planni Logistics and Mobility: Specialisation Productio		

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
Semiconductor Circuit Design (L076	3)	Lecture	3	4
Semiconductor Circuit Design (L086	(4)	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	physics		
	busies of physics, especially semiconductor	physics		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence Knowledge	Students are able to explain how anaStudents are able to explain the funcStudents know the fundamental digit	tionality of different MOS devices in electronic of log circuits functions and where they are applie tionality of fundamental operational amplifiers a al logic circuits and can discuss their advantage nory circuits and can explain their functionality for the use of bipolar transistors.	d. and their specificatio es 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. 			tronic circuits.
Personal Competence Social Competence	 Students are able work efficiently in Students working together in small g 	neterogeneous teams. roups can solve problems and answer professio	nal questions.	
Autonomy	Students are able to assess their leve	el of knowledge.		
Weyldend in House	Independent Chudu Tines 124 Chudu Tines i			
Credit points	Independent Study Time 124, Study Time ir	Lecture 56		
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German prog	ram, 7 semester): Specialisation Electrical Engir	eering: Compulsory	
Following Curricula	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechan	ical Engineering, F	ocus Mechatror
	Compulsory			
	Data Science: Core Qualification: Elective C	ompulsory		
	Electrical Engineering: Core Qualification: C	ompulsory		
	Engineering Science: Specialisation Electric	al Engineering: Compulsory		
	Engineering Science: Specialisation Mechat			
		am, 7 semester): Specialisation Electrical Engine		
		ogram, 7 semester): Specialisation Mechani	cal Engineering, F	ocus Mechatron
	Compulsory			
	5 5 7 5 7 5	am, 7 semester): Specialisation Mechatronics: C	1	
		ecialisation II. Mathematics & Engineering Scier	ice: Elective Compul	sory
	Mechanical Engineering: Specialisation Mec Mechatronics: Core Qualification: Compulso			
	mechacionics, core qualification, compuiso	' y		

	br Circuit Design
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 78, Study Time in Lecture 42
	Prof. Matthias Kuhl
Language	
Cycle	, sose
••••••	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 Deslications 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: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Dif	erential Equations) (11043)	Lecture	2	1
Differential Equations 2 (Partial Dif	-	Recitation Section (small)	1	1
Differential Equations 2 (Partial Dif	-	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
	Dref Anusch Toron		_	_
Module Responsible				
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence	51 5.	5 5		
-				
Knowledge	 Students can name the basic concepts in Mat 	thematics IV. They are able to explain the	n using appropri	ate examples.
	 Students can discuss logical connections bet 			
	the help of examples.			
		e them		
	 They know proof strategies and can reproduce 	.e metti.		
Skills	- · · · · · · · · · · · ·			
	 Students can model problems in Mathematic 		ed in this course	e. Moreover, they
	capable of solving them by applying establish	ned methods.		
	 Students are able to discover and verify furth 	er logical connections between the conce	pts studied in the	e course.
	 For a given problem, the students can deve 	elop and execute a suitable approach, a	nd are able to c	ritically evaluate
	results.			
Personal Competence				
Social Competence				
	• Students are able to work together in teams. They are capable to use mathematics as a common language.			
	 In doing so, they can communicate new cond 	cepts according to the needs of their coop	erating partners	. Moreover, they o
	design examples to check and deepen the un	derstanding of their peers.		
Autonomv				
Autonomy	 Students are capable of checking their unde 	rstanding of complex concepts on their o	wn. They can sp	ecify open question
	precisely and know where to get help in solvi	ng them.		
	 Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on har 			
	problems.		g	
	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 E	Equations 2)		
scale				
Assignment for the	General Engineering Science (German program, 7 s	emester): Specialisation Electrical Enginee	ering: Compulsor	У
Following Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering,	Focus Mechatron
	Compulsory			
	General Engineering Science (German program, 7 s	emester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 s	•		neoretical Mechani
	Engineering: Elective Compulsory	Encoder and a second second meeting and a second seco		
		thematica, Elective Computer and		
	Computer Science: Specialisation Computational Ma			
	Electrical Engineering: Core Qualification: Compulso			
	General Engineering Science (English program, 7 se	mester): Specialisation Electrical Enginee	ring: Compulsory	,
	General Engineering Science (English program,	7 semester): Specialisation Mechanica	l Engineering,	Focus Mechatron
	Compulsory			
	General Engineering Science (English program, 7 se	emester): Specialisation Mechanical Engin	eering, Focus Th	neoretical Mechani
		encestery, opecialisation meenanical Engli	icening, rocus II	.corecteur meeriali
	Engineering: Compulsory			
	Computational Science and Engineering: Specialisat		: Elective Compu	ulsory
	Mechanical Engineering: Specialisation Mechatronic	s: Compulsory		
	Mechanical Engineering: Specialisation Theoretical I	Mechanical Engineering: Elective Compuls	ory	
	Machatronica, Cara Qualification, Compulson,			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory Theoretical Mechanical Engineering: Technical Com	nlementary Course Core Studios: Elective	Compulsory	

Course L1043: Differential Ec	quations 2 (Partial Differential Equations)		
Тур	Lecture		
Hrs/wk	2		
СР			
Workload in Hours	ndependent Study Time 2, Study Time in Lecture 28		
Lecturer	ozenten des Fachbereiches Mathematik der UHH		
Language	Ε		
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 Fund	tions	
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.

	nced Mechanical Engine	aning besign			
Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Engineering			Lecture	2	2
Advanced Mechanical Engineering Advanced Mechanical Engineering			Recitation Section (large)	2	1 2
Advanced Mechanical Engineering	=		Lecture Recitation Section (large)	2	1
Module Responsible			Recitation Dection (large)	-	-
Admission Requirements					
Recommended Previous					
Knowledge	 Fundamentals of Mechanica 	Engineering Design			
-	Mechanics				
	Fundamentals of Materials S	cience			
	 Production Engineering 				
Educational Objectives	After taking part successfully, stud	ents have reached the follow	ving learning results		
Professional Competence					
Knowledge	After passing the module, students	are able to:			
	explain complex working pri	nciples and functions of may	chine elements and of basic ele	ments of fluidics	
	explain complex working pri explain requirements, select				
	 indicate the background of c 				ine elements,
		, , , , , , , , , , , , , , , , , , ,			
Skills	After passing the module, students	are able to:			
	 accomplish dimensioning ca 	Iculations of covered machir	ne elements,		
	transfer knowledge learned	in the module to new require	ements and tasks (problem sol	ving skills),	
	recognize the content of tec	hnical drawings and schema	itic sketches,		
	 evaluate complex designs, t 	echnically.			
Personal Competence					
Social Competence					
Social competence	Students are able to discuss	technical information in the	e lecture supported by activatir	ng methods.	
Autonomy					
Autonomy	Students are able to indepen	ndently deepen their acquire	ed knowledge in exercises.		
	Students are able to acquir	e additional knowledge and	to recapitulate poorly unders	tood content e.g	. by using the vid
	recordings of the lectures.				
Workload in Hours	Independent Study Time 68, Study	Time in Lecture 112			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and					
	120				
scale		nan program 7 semester): S			
scale Assignment for the	General Engineering Science (Gern		pecialisation Mechanical Engir	eering: Compulso	ory
Assignment for the	General Engineering Science (Gern General Engineering Science (Ge				
Assignment for the					
Assignment for the	General Engineering Science (Ge	erman program, 7 semest	er): Specialisation Mechanica	l Engineering, F	ocus Biomechanio
Assignment for the	General Engineering Science (Ge Compulsory	erman program, 7 semest	er): Specialisation Mechanica	l Engineering, F	ocus Biomechanio
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge	erman program, 7 semest rman program, 7 semester	er): Specialisation Mechanica r): Specialisation Mechanical	l Engineering, F Engineering, Foc	ocus Biomechanio us Energy System
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory	erman program, 7 semest rman program, 7 semester rman program, 7 semester	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical	l Engineering, F Engineering, Foc Engineering, Foc	ocus Biomechanio us Energy System us Aircraft Syster
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (G	erman program, 7 semest rman program, 7 semester rman program, 7 semester erman program, 7 semes	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical	l Engineering, F Engineering, Foc Engineering, Foc	ocus Biomechanio us Energy System us Aircraft Syster
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (G Engineering Sciences: Compulsory	erman program, 7 semest rman program, 7 semester rman program, 7 semester erman program, 7 semes	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanic	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering,	ocus Biomechanio us Energy System us Aircraft Syster Focus Materials
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (G Engineering Sciences: Compulsory General Engineering Science (Ge	erman program, 7 semest rman program, 7 semester rman program, 7 semester erman program, 7 semes	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanic	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering,	ocus Biomechanio us Energy System us Aircraft Syster Focus Materials
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ge Compulsory	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, I al Engineering, I	ocus Biomechanic us Energy System us Aircraft Syster Focus Materials Focus Mechatronic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Gen Compulsory General Engineering Science (Gen	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, I al Engineering, I	ocus Biomechanic us Energy System us Aircraft Syster Focus Materials Focus Mechatronic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Ger and Production: Compulsory	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester):	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica Specialisation Mechanical Eng	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Gen Compulsory General Engineering Science (Gen	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester):	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica Specialisation Mechanical Eng	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): nan program, 7 semester): 5	er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (ter): Specialisation Mechanica (ter): Specialisation Mechanical Engli Specialisation Mechanical Engli	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): S ementary Course Core Studie	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanica Specialisation Mechanical Engines Specialisation Mechanical Engines se: Elective Compulsory	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): sementary Course Core Studie n Mechanical Engineering: Co	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanica Specialisation Mechanical Engines Specialisation Mechanical Engineses Specialisation Mechanic	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P neering, Focus Th	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme ecoretical Mechanic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisation	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): S ementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanical Specialisation Mechanical Engines se: Elective Compulsory ompulsory pecialisation Mechanical Engine	al Engineering, F Engineering, Foc Engineering, Foc cal Engineering, F al Engineering, F ineering, Focus P neering, Focus Th eering: Compulso	iocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): S ementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp	er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanical Specialisation Mechanical Engines se: Elective Compulsory ompulsory pecialisation Mechanical Engine	al Engineering, F Engineering, Foc Engineering, Foc cal Engineering, F al Engineering, F ineering, Focus P neering, Focus Th eering: Compulso	iocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli General Engineering Science (Engli General Engineering Science (Engli	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): sementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp nglish program, 7 semester	er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical Englisition Mechanical Englises (): Specialisation Mechanical Englises (): Elective Compulsory (): Specialisation Mechanical Englises (): Specialisation Mechanical Engl	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, I ineering, Focus P neering, Focus Th eering: Compulso I Engineering, F	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic ry ocus Biomechanic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli General Engineering Science (Engli	erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): sementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp nglish program, 7 semester	er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical Englisition Mechanical Englises (): Specialisation Mechanical Englises (): Elective Compulsory (): Specialisation Mechanical Englises (): Specialisation Mechanical Engl	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, I ineering, Focus P neering, Focus Th eering: Compulso I Engineering, F	ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic ry ocus Biomechanic
Assignment for the	General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli General Engineering Science (Engli	erman program, 7 semester rman program, 7 semester rman program, 7 semester erman program, 7 semester erman program, 7 semest man program, 7 semester): man program, 7 semester): mentary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp nglish program, 7 semester glish program, 7 semester	er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical Englise Specialisation Mechanical Englise (): Specialisation Mechanical Englise (): Specialisation Mechanical Englise (): Specialisation Mechanical Englise (): Specialisation Mechanical Inglise (): Specialisat	I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, Foc al Engineering, I ineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc	iocus Biomechanie us Energy System us Aircraft System Focus Materials Focus Mechatronie roduct Developme roduct Developme roretical Mechanie ry ocus Biomechanie us Energy System

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
Mechanical Engineering: Core Qualification: Compulsory
Naval Architecture: Core Qualification: Compulsory

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	
	• Elements of hubbles	
	Exercise	
	Calculation methods of the following machine elements:	
	Linear rolling bearings	
	• Axes & shafts	
	Clutches & brakes	
	• Belt & chain drives	
	Gear drives Friendle and a	
	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	ation 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		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
	Prof. Dieter Krause, Prof. Otto von Estorff	
Language		
	WiSe	
-	Advanced Mechanical Engineering Design I & II	
	Lecture	
	Fundamentals of the following machine elements:	
	 Linear rolling bearings 	
	Axes & shafts	
	• Seals	
	Clutches & brakes	
	Belt & chain drives	
	Gear drives	
	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 	
	 Maschineheinente - 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	
itle dvanced Mechanical Design Proje	Typ Hrs/wk CP ect (L0266) Project-/problem-based Learning 4 6
Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	Mechanical Engineering: Design
j-	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module, students are able to:
	express the procedure for systematically handling of
	 complex design tasks , describe working principles, their use and combination possibilities,
	 explain guidelines for designing for function and manufacturing,
	 explain galaxies of designing of 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:
	 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	
-	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 (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		Turn	Hrs/wk	СР
Fundamentals of Machine Tools (L0	689)	Typ Lecture	2	2
Fundamentals of Machine Tools (L1		Recitation Section (large)	1	1
Forming and Cutting Technology (L	0613)	Lecture	2	2
Forming and Cutting Technology (L	0614)	Recitation Section (large)	1	1
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
	without major course assessment			
Knowledge	internship recommended			
	Previous knowledge in mathematics, mechanics a	nd electrical engineering		
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
-	Students are able to			
	- evaluin the basics of this formation			
	 explain the basics of chip formation and me explain methods and parameters for design 		recorder and to	
	 explain methods and parameters for design explain technical concepts of machine tool 			
	 explain types, constructions and functions of 			
	 explain equipment components. 			
Skills	Students are able to			
			in a ta shaita a ta	
	 select tool geometry, cutting materials, pro requirements. 	ocess parameters and appropriate measur	ing technique in	accordance with tr
	 estimate occurring forces and temperatures 	during chip formation		
	 select appropriate machine tools for machine 		d milling.	
	assess the quality of a machine tools and to			
Personal Competence				
Social Competence	Students are able to			
	• develop solutions in a production environme	ent with qualified personnel at technical lev	el and represent	decisions.
Autonomy	Students are able to			
	 interpret independently cutting processes. 			
	 create independently NC programs. 			
	 select independently machine tools by refer 	ence to appropriate requirements.		
	 assess own strengths and weaknesses in get 			
	 assess their learning progress and define gate 	aps to be improved.		
	 assess possible consequences of their actio 	ns.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture	e 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	180 min			
scale				
-	General Engineering Science (German program, 7	semester): Specialisation Mechanical Eng	ineering, Focus F	roduct Developme
Following Curricula	and Production: Compulsory	comotor), Chosialization Machaniat	nooring Frances	Iroduct Devictore
	General Engineering Science (English program, 7	semester): specialisation Mechanical Eng	neering, Focus P	TOQUET Development
	and Production: Compulsory			
	Mechanical Engineering: Specialisation Product De	velopment and Production: Compulson		

Course L0689: Fundamentals	of Mashina Taala
Тур Hrs/wk	2
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

Course L1992: Fundamentals	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	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	 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	ourse 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	

	iction Engineering			
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	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous	no course assessments required			
Knowledge				
laiomeage	internship recommended			
-	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
	 name basic criteria for the selection o 	of manufacturing processos		
	name the main groups of Manufacturi			
	 name the application areas of different 			
		sadvantages of the different manufacturing proce		
	 describe elements, geometric propert 	ties and kinematic variables and requirements for	r tools, workpiece	and process.
	 explain the essential models of manufactorial 	facturing technology.		
Skills	Students are able to			
	 select manufacturing processes in acc 	cordance with the requirements.		
	 design manufacturing processes for signature 	imple tasks to meet the required tolerances of th	ne component to b	pe produced.
	 assess components in terms of their p 	production-oriented construction.		
Personal Competence				
	Students are able to			
Social Competence				
	 develop solutions in a production envi 	ironment with qualified personnel at technical lev	vel and represent	decisions.
Autonomic	Students are able to			
Autonomy				
	 interpret independently the manufact 	uring process.		
	 assess own strengths and weaknesses 	s in general.		
	 assess their learning progress and de 	-		
	 assess possible consequences of their 			
	• assess possible consequences of them	actions.		
Workload in Hours	Independent Study Time 96, Study Time in L	Lecture 84		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German progr	ram, 7 semester): Specialisation Mechanical Eng	gineering, Focus P	Product Developn
Following Curricula	and Production: Compulsory			
	General Engineering Science (German progr	ram, 7 semester): Specialisation Mechanical Engi	ineering, Focus Th	neoretical Mechar
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qualific	cation: Compulsory		
	Engineering Science: Specialisation Mechani			
			ooring. Commut-	1
		am, 7 semester): Specialisation Mechanical Engin		
		am, 7 semester): Specialisation Mechanical Engi	neering, Focus Th	neoretical Mechar
	Engineering: Elective Compulsory			
	Green Technologies: Energy, Water, Climate	e: Specialisation Energy Technology: Elective Com	npulsory	
	Logistics and Mobility: Specialisation Product	tion Management and Processes: Compulsory		
	1			
	Logistics and Mobility: Specialisation Engine	ering Science: Elective Compulsory		
	Mechanical Engineering: Core Qualification:	Compulsory		
		Compulsory		

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

Course L0610: Production 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		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 re	ached the following learning results		
Professional Competence				
Knowledge	 This module deals with the foundations of the programming down to gates. The module inclusion Introduction 		ers the layers fron	n the assembly-le
	 Sequential logic: Flip-flops, automata, sy Technological foundations Computer arithmetic: Integer addition, si Basics of computer architecture: Program Memories: Memory hierarchies, SRAM, D 	ubtraction, multiplication and division nming models, MIPS single-cycle architecture	e, pipelining	
Skills	The students perceive computer systems from composition of computer systems. The student collection of few and simple components. The today's computing systems - from gates and ci After successful completion of the module, th system and the software executed on it. In par on the hardware-centric abstraction layers fror the impact that these low abstraction levels ha	s can analyze, how highly specific and indivi y are able to distinguish between and to ex rcuits up to complete processors. e students are able to judge the interdepen ticular, they shall understand the consequen n the assembly language down to gates. Thi	dual computers can plain the different indencies between inces that the exect s way, they will be	n be built based o abstraction layers a physical compu- ution of software l enabled to evalu
Borconal Competence				
Personal Competence		no or in a group and to present the results a	cordingly	
Social Competence	Students are able to solve similar problems alo	ne or in a group and to present the results a	cordingly.	
Autonomy	Students are able to acquire new knowledge fro	om specific literature and to associate this kr	nowledge with othe	r classes.
Werkleed in Heure	Independent Study Time 124. Study Time in Le	atura FC		
	Independent Study Time 124, Study Time in Le	cture 56		
Credit points Course achievement		Description		
course acmevement	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 semester): Specialisation Computer Scier	nce: Compulsory	
Following Curricula	General Engineering Science (German program	, 7 semester): Specialisation Civil Engineerin	g: Compulsory	
	General Engineering Science (German program	, 7 semester): Specialisation Process Engine	ering: Compulsory	
	General Engineering Science (German progr	ram, 7 semester): Specialisation Mechani	cal Engineering, I	Focus Mechatron
	Compulsory			
	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanica	l Engineering, Foc	us Aircraft Syste
	Engineering: Compulsory			
	General Engineering Science (German program	 7 semester): Specialisation Mechanical End 	gineering, Focus Th	eoretical Mechan
		,,		
	Engineering: Compulsory			
	Engineering: Compulsory General Engineering Science (German prog		nical Engineering,	
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory	ram, 7 semester): Specialisation Mechar		Focus Materials
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program	ram, 7 semester): Specialisation Mechar		Focus Materials
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory	ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er	ngineering, Focus P	Focus Materials Product Developm
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory	ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er	ngineering, Focus P	Focus Materials Product Developm
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program	rram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica	ngineering, Focus P I Engineering, Foc	Focus Materials Product Developm us Energy System
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory	rram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica	ngineering, Focus P I Engineering, Foc	Focus Materials Product Developm us Energy System
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program)	ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin	ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory	Focus Materials Product Developm us Energy System Focus Biomechan Pry Y
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program	ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo	ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory	Focus Materials Product Developm us Energy System Focus Biomechan Pry Y
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program	ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanic , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo	ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory	Focus Materials Product Developm us Energy System Focus Biomechan Pry Y
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory Computer Science: Core Qualification: Compulsor	ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo ory pulsory	ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory	Focus Materials Product Developm us Energy System Focus Biomechan Pry Y
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory Computer Science: Core Qualification: Compuls	ram, 7 semester): Specialisation Mechan n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo ory pulsory	ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory ogies, Focus Renew	Focus Materials Product Developm us Energy Syste Focus Biomechan Pry Y
	Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science) (German program Gene	ram, 7 semester): Specialisation Mechan n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo ory pulsory oulsory 7 semester): Specialisation Civil Engineering	ngineering, Focus P I Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory ineering: Compulsory ogies, Focus Renew g: Compulsory	Focus Materials Product Developm us Energy Syste Focus Biomechan Pry Pry dable Energy: Elec

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
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/EN
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	gineering
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/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0599: Integ	rated Product I	Development and	d Lightweigh	t Design		
Courses						
Title				Тур	Hrs/wk	СР
CAE-Team Project (L0271)				Project-/problem-based Learning	2	2
Development of Lightweight Design	n Products (L0270)			Lecture	2	2
Integrated Product Development I ((L0269)			Lecture	2	2
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
	Advanced Knowledge	about engineering desi	gn:			
Knowledge	Fundamentals of Mec	hanical Engineering Des	ign			
	Mechanical Engineeri	ng: Design				
	Advanced Mechanical					
Educational Objectives	After taking part succ	essfully, students have	reached the followi	ng learning results		
Professional Competence						
Knowledge	After completing the	module, students are ca	pable of:			
	 explaining the 	functional principle of 3	D-CAD-Systems, PD	M- and FEM-Systems		
				the product development proces	SS	
Skills						
	After completing the	module, students are ab	le to:			
	 evaluate differ 	ent CAD- and PDM-Sys	tems with regards	to the desired requirements su	ich as classific	ation schemes and
	product structu	ıring				
	 design an exer 	nplary product using CA	D-,PDM- and/or FEN	1-Systems with shared workload		
Personal Competence						
Social Competence	After completing the	module, students are ab	le to:			
	 To develop a p 	roiect plan and allocate	work appropriate w	ork packages in the framework	of aroup discu	ssions
		results as a team for in			<u>5</u> p	
Autonomy	Students are capable	of:				
	 independently 	adapt to a CAE-Tool and	l complete a given	practical task with it		
		· · · · · · · · · · · · · · · · · · ·				
Workload in Hours	Independent Study Ti	me 96, Study Time in Le	ecture 84			
Credit points						
Course achievement		Form	Description	ojekt inkl. Vortrag und Ausarbeitu	ing	
	Yes 20 %	Subject theoretical practical work	and CAL-reampio	Jekt linki. Volti ag ullu Ausai belu	ing	
Examination	Written exam	proceeding				
Examination duration and	1					
scale						
Assignment for the		Science (German proc	Iram, 7 semester)	: Specialisation Mechanical End	ineering, Focu	is Aircraft Systems
Following Curricula		sory				
_	General Engineering	Science (German progra	am, 7 semester): S	pecialisation Mechanical Engine	ering, Focus Pr	oduct Development
	and Production: Comp	oulsory				
	Engineering Science:	Specialisation Mechanic	al Engineering: Ele	ctive Compulsory		
	General Engineering	Science (English prog	ram, 7 semester):	Specialisation Mechanical Eng	ineering, Focu	is Aircraft Systems
	Engineering: Compuls	sory				
	General Engineering	Science (English progra	m, 7 semester): S	pecialisation Mechanical Enginee	ering, Focus Pr	oduct Development
	and Production: Comp	oulsory				
				ecialisation Mechanical Engineeri	ng: Elective Co	mpulsory
	-			d Production: Compulsory		
	-	ng: Specialisation Aircra				
	Product Development	, Materials and Producti	on: Technical Comp	plementary Course Core Studies:	Elective Comp	ulsory

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	Lecture
Hrs/wk	2
CP	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 Pr	oduct Development l
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause
Language	DE
Cycle	SoSe
Content	 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 M0865: Funda	mentals of Production and	l Quality Management		
Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (LC	0925)	Lecture	2	3
Quality Management (L0926)		Lecture	2	3
Module Responsible	Prof. Hermann Lödding			
Admission Requirements				
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the conten	ts of the lecture of the module.		
Skills	Students are able to apply the methods	and models in the module to industrial problem	S.	
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Tir	ne 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 Mecha	nical Engineering, Foc	us Aircraft Systems
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German	program, 7 semester): Specialisation Mechanica	al Engineering, Focus P	Product Development
	and Production: Compulsory			
	Engineering Science: Core Qualification			
		rogram, 7 semester): Specialisation Mechanical B		ompulsory
		rogram, 7 semester): Core Qualification: Compul	-	
		oduction Management and Processes: Compulso	ry	
		gineering Science: Elective Compulsory		
	Mechanical Engineering: Core Qualificat			
	Engineering and Management - Major in	n Logistics and Mobility: Specialisation Production	n Management and Pro	cesses: Compulsory

Course L0925: Production Pr	ocess Organization		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	ependent 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	gement
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

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.

	nced Mechanical Engin				
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)	2	-
Module Responsible					
Admission Requirements					
Recommended Previous	 Fundamentals of Mechani 	cal Engineering Design			
Knowledge	Mechanics				
	Fundamentals of Materials	s Science			
	Production Engineering				
	After taking part successfully, st	udents have reached the fo	llowing learning results		
Professional Competence					
Knowledge	After passing the module, studer	its are able to:			
	explain complex working	principles and functions of	machine elements and of basic ele	ments of fluidics,	
			cenarios and practical examples o		
	 indicate the background of 	of dimensioning calculations	5.		
	After a second the second s	ata ang abla tu			
Skills	After passing the module, studer	its are able to:			
	accomplish dimensioning	calculations of covered ma	chine elements,		
	transfer knowledge learne	ed in the module to new rec	uirements and tasks (problem sol	ving skills),	
	 recognize the content of t 	echnical drawings and sche	ematic sketches,		
	evaluate complex designs	, technically.			
Personal Competence					
Social Competence	 Students are able to discu 	iss technical information in	the lecture supported by activatin	g methods.	
				5	
Autonomy		pendently deepen their acq	uired knowledge in exercises.		
			and to recapitulate poorly unders	tood content e a	by using the vid
	recordings of the lectures		and to recupitulate poorly anders	cood content e.g	. by using the vie
	· · · · · · · · · · · · · · · · · · ·	·			
Workload in Hours	Independent Study Time 68, Stu	dy Time in Lecture 112			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120				
Examination duration and					
Examination duration and scale					
scale	General Engineering Science (Ge	erman program, 7 semester): Specialisation Mechanical Engin	eering: Compulso	ory
scale Assignment for the): Specialisation Mechanical Engin ester): Specialisation Mechanica		-
scale Assignment for the					-
scale Assignment for the	General Engineering Science (Compulsory	(German program, 7 sem		l Engineering, F	ocus Biomechani
scale Assignment for the	General Engineering Science (Compulsory	(German program, 7 sem	ester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory	(German program, 7 sem German program, 7 seme	ester): Specialisation Mechanica	l Engineering, F Engineering, Foci	ocus Biomechani us Energy Syster
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory	(German program, 7 sem German program, 7 seme	ester): Specialisation Mechanica ster): Specialisation Mechanical I	l Engineering, F Engineering, Foci	ocus Biomechani us Energy Syster
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme	ester): Specialisation Mechanica ster): Specialisation Mechanical I	I Engineering, F Engineering, Foci Engineering, Foc	ocus Biomechani us Energy Syster us Aircraft Syste
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical	I Engineering, F Engineering, Foci Engineering, Foc	ocus Biomechani us Energy Syster us Aircraft Syste
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical	I Engineering, F Engineering, Focu Engineering, Focu al Engineering,	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanic	I Engineering, F Engineering, Focu Engineering, Focu al Engineering,	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (G	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sen ry (German program, 7 sen	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanic	I Engineering, F Engineering, Foct Engineering, Foc al Engineering, F I Engineering, F	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry (German program, 7 sem erman program, 7 semeste	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical mester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Eng	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (G	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry (German program, 7 sem erman program, 7 semeste	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Ganderoduction: Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical mester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stra ion Mechanical Engineering	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir udies: Elective Compulsory : Compulsory	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P heering, Focus Th	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P heering, Focus Th	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Com Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science))	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester)	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir udies: Elective Compulsory : Compulsory	I Engineering, F Engineering, Foc Engineering, Foc al Engineering, F I Engineering, F ineering, Focus P heering, Focus Th	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Com Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science))	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester)	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin c): Specialisation Mechanical Engin c): Specialisation Mechanical Engine	I Engineering, F Engineering, Foc Engineering, Foc al Engineering, F I Engineering, F ineering, Focus P heering, Focus Th	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science) General Engineering Science (Engineering Science)	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester) (English program, 7 sem	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin c): Specialisation Mechanical Engin c): Specialisation Mechanical Engine	I Engineering, F Engineering, Foc Engineering, Foc al Engineering, Foc I Engineering, Focus P heering, Focus Th eering: Compulson I Engineering, F	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science) General Engineering Science (Engineering Science)	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester) (English program, 7 sem	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin clies: Elective Compulsory : Compulsory : Specialisation Mechanical Engine ester): Specialisation Mechanical Engine	I Engineering, F Engineering, Foc Engineering, Foc al Engineering, Foc I Engineering, Focus P heering, Focus Th eering: Compulson I Engineering, F	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Science (Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science (General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem ry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu ion Mechanical Engineering iglish program, 7 seme English program, 7 semes	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin clies: Elective Compulsory : Compulsory : Specialisation Mechanical Engine ester): Specialisation Mechanical Engine	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, Foci I Engineering, Focus P heering, Focus Th eering: Compulsor I Engineering, Focu	us Energy Syster us Aircraft Syster Focus Materials Focus Mechatroni roduct Developme eoretical Mechani
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 seme ry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu ion Mechanical Engineering iglish program, 7 seme English program, 7 semeste English program, 7 semeste	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica nester): Specialisation Mechanica ester): Specialisation Mechanical Engin (): Specialisation Mechanical Engin (): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine (): Specialisation Mechanical Engine	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, Foci I Engineering, Focus P heering, Focus Th eering: Compulsoi I Engineering, Foci Engineering, Foci	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani ry ocus Biomechani us Energy Syster us Aircraft Syste
scale Assignment for the	General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory	(German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 seme ry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu ion Mechanical Engineering iglish program, 7 seme English program, 7 semeste English program, 7 semeste	ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical I nester): Specialisation Mechanica nester): Specialisation Mechanica er): Specialisation Mechanical Engin (): Specialisation Mechanical Engin (): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine (): Specialisation Mechanical Engine	I Engineering, F Engineering, Foci Engineering, Foci al Engineering, Foci I Engineering, Focus P heering, Focus Th eering: Compulsoi I Engineering, Foci Engineering, Foci	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani ry ocus Biomechani us Energy Syster us Aircraft Syste

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

ourse L0264: Advanced Me	chanical Engineering Design II
Тур	
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.
	 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 Me	Course L0265: Advanced Mechanical Engineering Design II	
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

τνρ	Lecture
Hrs/wk	
CP	
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
	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.
	 Bubbel, Taschenbuch für den Maschnenbad, Glote, K. H., Feldhäsen, J. (1939.), 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 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				
Title		Тур	Hrs/wk	СР
Heat Transfer (L0458)		Lecture	3	4
Heat Transfer (L0459)		Recitation Section (large)	2	2
Module Responsible	Dr. Andreas Moschallski			
Admission Requirements	None			
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics			
Knowledge Educational Objectives	After taking part successfully, students have reached the folio	wing loarning rocults		
Professional Competence	Arter taking part successionly, students have reached the fond			
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Transfer,			
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way.			
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 groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develop	an approach.		
Autonomy	The students are able to develop a complex problem self-con with other students is given.	sistent and analyse the results i	n a critical way. A	qualified exchan
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 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical I	Engineering, Foc	us Energy Systen
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 semester):			-
	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engir	ieering, Focus Th	eoretical Mechanio
	Engineering: Compulsory			
	Energy Systems: Technical Complementary Course Core Stud			
	General Engineering Science (English program, 7 semeste	er): Specialisation Mechanical I	ngineering, Foci	us Energy Systen
	Compulsory		anian Canada	
	General Engineering Science (English program, 7 semester): 9		ering: Compulsor	У
	Mechanical Engineering: Specialisation Energy Systems: Com	· -		
	Mechanical Engineering: Specialisation Theoretical Mechanica	u Fuqineering: Flective Compuls		

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

Course L0459: Heat Transfer	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		Tree	Line (sule	СР
Computational Fluid Dynamics I (L0	1235)	Typ Lecture	Hrs/wk 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 of 	alculus and series expansions		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence	······	· · · · · · · · · · · · · · · · · · ·		
	The students are able to list the basic numer	ics of partial differential equations		
Kilowicage	The statents are able to list the basic human	ies of partial afferential equations.		
Skille	The students are able develop appropriate p	umerical integration in space and time for the g	noverning partial d	ifferential equation
SKIIS	They can code computational algorithms in a		jovenning partial a	incrential equation
	They can code computational algorithms in a	Statuta way.		
Personal Competence				
Social Competence	The students can arrive at work results in gro	oups and document them.		
Autonomy	The students can independently analyse app	roaches to solving specific problems.		
We what a set has the same	la des en destr Charles Times 124. Charles Times in l			
	Independent Study Time 124, Study Time in	Lecture 56		
Credit points				
Course achievement	None			
	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechan
Following Curricula	Engineering: Elective Compulsory			
		gram, 7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	Engineering: Elective Compulsory			
		gram, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syste
	Elective Compulsory			
		am, 7 semester): Specialisation Naval Architectu		
		am, 7 semester): Specialisation Energy and Env	iromentai Engineei	ring: Compulsory
	Energy Systems: Technical Complementary C		omontal Engineer	ing: Compulsors
		m, 7 semester): Specialisation Energy and Envir	-	
		ram, 7 semester): Specialisation Mechanical	Engineering, FOC	us Literyy Syster
	Elective Compulsory General Engineering Science (English program	m, 7 semester): Specialisation Naval Architectu	re: Compulson	
		rram, 7 semester): Specialisation Naval Architectu		us Aircraft Svete
	Engineering: Elective Compulsory	nam, / semester). Specialisation Mechanical	Ligineening, FOC	as Ancidit Syste
	Engineering, Elective CUIIDUISULV			
		v Systems: Elective Compulsory		
	Mechanical Engineering: Specialisation Energ			
	Mechanical Engineering: Specialisation Energ	aft Systems Engineering: Elective 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	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	None			
Recommended Previous	 Mathematik I + II for Engineering Students (germ 	an or english) or Analysis & Linear Al	aebra I + II for Te	chnomathematic
Knowledge	basic MATLAB/Python knowledge			
	After taking part successfully, students have reached th	e following learning results		
Professional Competence	Churd and a sur a blacks			
Knowleage	Students are able to			
	 name numerical methods for interpolation, integ 	ration, least squares problems, eigenv	value problems, r	onlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the numerical 			
	 explain aspects for the practical execution of nur 	nerical methods with respect to comp	utational and stor	rage complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical method 	ds using MATLAB/Python,		
	 justify the convergence behaviour of numerical r 	nethods with respect to the problem a	nd solution algori	thm,
	 select and execute a suitable solution approach 	or a given problem.		
Personal Competence				
•	Students are able to			
Social competence				
	 work together in heterogeneously composed tea 	ms (i.e., teams from different study p	rograms and bac	kground knowled
	explain theoretical foundations and support each	other with practical aspects regarding	g the implementa	tion of algorithm
Autonomy	Students are capable			
	 to assess whether the supporting theoretical and 		individually or in	i a team,
	 to assess their individual progess and, if necessa 	ry, 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			
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Computer Science	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 seme			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechai
	Compulsory	octor), Specialization Mechanical Engli	pooring Focus Th	oprotical Mocha
	General Engineering Science (German program, 7 seme Engineering: Compulsory	.ster). Specialisation Methanital Engli	icening, rocus III	corecicar Mecilal
	General Engineering Science (German program, 7 s	emester): Specialisation Mechanical	Engineering Foo	us Aircraft Svst
	Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 sem	ester): Specialisation Mechanical Engi	neering, Focus M	echatronics: Elec
	Compulsory		J,	
		emester): Specialisation Mechanical I	Engineering, Foc	us Energy Syste
	General Engineering Science (German program, 7 s			
	Elective Compulsory			
		rocess Engineering: Elective Compulso	ory	
	Elective Compulsory		ory	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop	matics: Elective Compulsory		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe	matics: Elective Compulsory		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com	matics: Elective Compulsory ngineering Science: Elective Compulso		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory	bry	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science	ry : Compulsory	ocus Piomocha
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science	ry : Compulsory	ocus Biomechai
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanica	ory : Compulsory I Engineering, F	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanica	ory : Compulsory I Engineering, F	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine	ory : Compulsory I Engineering, F eering, Focus Mat	erials in Enginee
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine	ory : Compulsory I Engineering, F eering, Focus Mat	erials in Enginee
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engin ster): Specialisation Mechanical Engin	: Compulsory I Engineering, F eering, Focus Mat eeering, Focus Th	eerials in Enginee eoretical Mechae
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory	matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine ster): Specialisation Mechanical Engine	: Compulsory I Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso	erials in Enginee eoretical Mechai Y

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I	
Тур	Lecture	
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne	
Language	EN	
Cycle	WiSe	
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 	
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 	

Course L0418: Numerical Ma	Irse 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)		Recitation Section (large)	1	1	
Production Engineering II (L0610) Production Engineering II (L0611)		Lecture Recitation Section (large)	2	2 1	
Module Responsible	Prof Wolfgang Hintze	Recitation Section (large)	1	1	
-	None				
-	no course assessments required				
Knowledge					
-	internship recommended				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results			
Professional Competence					
Knowledge	Students are able to				
	name basic criteria for the selection				
	name the main groups of Manufactur				
	 name the application areas of difference 				
	-	isadvantages of the different manufacturing proc			
		rties and kinematic variables and requirements for	or tools, workpiece	and process.	
	 explain the essential models of manual 	ufacturing technology.			
ci "	C 1 1 1				
SKIIIS	Students are able to				
	 select manufacturing processes in ad 	ccordance with the requirements.			
	 design manufacturing processes for 	simple tasks to meet the required tolerances of t	he component to b	pe produced.	
	 assess components in terms of their 	production-oriented construction.			
Personal Competence					
Social Competence	Students are able to				
	 develop solutions in a production environment with qualified personnel at technical level and represent decisions. 				
	• develop solutions in a production en	with qualities personnel at technical le	ver and represent	decisions.	
Autonomy	Students are able to				
	- interret independently the percent				
	 interpret independently the manufaction of the second secon				
	 assess own strengths and weakness 				
	 assess their learning progress and d 				
	 assess possible consequences of the 	ir actions.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84			
workload in nours	independent study nine 90, study nine in				
Credit points	6				
Course achievement	None				
Examination					
Examination duration and	120 min				
scale					
-		gram, 7 semester): Specialisation Mechanical En	gineering, Focus I	Product Developn	
Following Curricula	and Production: Compulsory				
		ram, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	neoretical Mechar	
	Engineering: Elective Compulsory				
	Digital Mechanical Engineering: Core Qualif	ication: Compulsory			
	Engineering Science: Specialisation Mechar	nical Engineering: Compulsory			
	General Engineering Science (English progr	am, 7 semester): Specialisation Mechanical Engir	neering: Compulso	ory	
	General Engineering Science (English prog	ram, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	neoretical Mechar	
	Engineering: Elective Compulsory				
	Green Technologies: Energy, Water, Climat	e: Specialisation Energy Technology: Elective Cor	npulsory		
	Logistics and Mobility: Specialisation Produc	ction Management and Processes: Compulsory			
	Logistics and Mobility: Specialisation Engine				
	Mechanical Engineering: Core Qualification:				
	incentancear Engineering. core Qualmeation.				
	Mechatronics: Core Qualification: Compulso				

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	ourse 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	igineering 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	urse 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		

	puter Engineering			
Courses				
Title	Тур	Hrs/wk	СР	
Computer Engineering (L0321) Computer Engineering (L0324)	Lecture Recitation Section (small)	3 1	4 2	
Module Responsible		Ţ	Z	
Admission Requirements				
	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	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-le programming down to gates. The module includes the following topics: Introduction 			
	 Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesi 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 		tworks	
	 Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point- 	to-point connections	s, busses	
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based of collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical compu- system and the software executed on it. In particular, they shall understand the consequences that the execution of software layers on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evalu			
	the impact that these low abstraction levels have on an entire system's performance and	to propose feasible	options.	
Personal Competence	9			
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	i 6			
Course achievement				
From the state of	Yes 10 % Excercises			
scale	90 minutes, contents of course and labs			
	General Engineering Science (German program, 7 semester): Specialisation Computer Sci	ience: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Civil Engineer			
	General Engineering Science (German program, 7 semester): Specialisation Process Engir General Engineering Science (German program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanic Engineering: Compulsory	nical Engineering,	Focus Mechatron cus Aircraft Syste	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical E Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mech			
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical and Production: Compulsory	Engineering, Focus	Product Developm	
	General Engineering Science (German program, 7 semester): Specialisation Mechanic Compulsory			
		nical Engineering,		
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Archite General Engineering Science (German program, 7 semester): Specialisation Biomedical Er General Engineering Science (German program, 7 semester): Specialisation Bioprocess Er General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Green Techno Compulsory	nical Engineering, cture: Compulsory ngineering: Compuls ngineering: Compuls jineering: Compulso	Focus Biomechan Fory ory TY	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Archite General Engineering Science (German program, 7 semester): Specialisation Biomedical Er General Engineering Science (German program, 7 semester): Specialisation Bioprocess Er General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Green Techno	nical Engineering, ecture: Compulsory ngineering: Compuls ngineering: Compulso plogies, Focus Renew	Focus Biomechar ory ory ry vable Energy: Elec	

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
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	cture		
Hrs/wk			
CP	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Heiko Falk		
Language	DE/EN		
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	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/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Turn	Line (suite	СР
Electrical Machines and Actuators	(10293)	Typ Lecture	Hrs/wk 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 comple	exe numbers, integrals, differentials		
Knowledge	Basics of electrical engineering and mecha	nical ongineering		
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	Students can to draw and explain the basic	principles of electric and magnetic fields.		
	They can describe the function of the	standard types of electric machines and pres	ent the correspon	ding equations a
		ves they can explain the major parameters of the		
	from the power grid to the driven engine.		5, ,	2
Skills		ional electric and magnetic fields in particular f	erromagnetic circu	uits with air gap. F
	this they apply the usual methods of the de	sign auf electric machines.		
	They can calulate the operational perform	ance of electric machines from their given char	acteristic data and	d selected quantiti
	and characteristic curves. They apply the u	sual equivalent circuits and graphical methods.		
Personal Competence				
Social Competence	e none			
Autonomy		te electric and magnatic fields for applications. T		
		achines from the charactersitic data and theyca	n calculate thereo	f selected quantit
	and characteristic curves.			
Warkland in Hours	Independent Study Time 110, Study Time i	a Locturo 70		
	Independent Study Time 110, Study Time in	T Lecture 70		
Credit points Course achievement				
	Subject theoretical and practical work Design of four machines and actuators, rev	iow of docign files		
scale	Design of four machines and actuators, rev	lew of design files		
	General Engineering Science (German prog	ram, 7 semester): Specialisation Electrical Engine	eering: Elective Co	mpulsory
Following Curricula		ogram, 7 semester): Specialisation Electrical English		
j	Compulsory		5 5 5, 5	
	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanic	cal Engineering, I	Focus Mechatronio
	Compulsory			
	General Engineering Science (German prog	ram, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	eoretical Mechani
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core Qualif			
	Electrical Engineering: Core Qualification: E			
	Energy and Environmental Engineering: Col		nooring: Elective C	
		am, 7 semester): Specialisation Mechanical Engine Specialisation Energy Technology: Elective Col		ompulsory
	Logistics and Mobility: Specialisation Engine	e: Specialisation Energy Technology: Elective Con pering Science: Elective Compulsory	npaisory	
		Planning and Systems: Elective Compulsory		
		ction Management and Processes: Elective Comp	ulsory	
	Mechanical Engineering: Core Qualification:			
	Mechatronics: Core Qualification: Compulso			
	Technomathematics: Specialisation III. Engi			
	Engineering and Management - Major in Lo	gistics and Mobility: Specialisation Traffic Plannin	g and Systems: Ele	ective Compulsory
	Engineering and Management - Major in I	ogistics and Mobility: Specialisation Production	Management and	Processes: Electi

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
CP	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
Modeling, Simulation and Optimiza	tion (L2446)	Integrated Lecture	4	6
Module Responsible	Prof. Benedikt Kriegesmann			
Admission Requirements	None			
Recommended Previous	Sound knowledge of engineering mathematics	, engineering mechanics and fluid mechanics	5	
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	Students will have an overview of various tee	hnical problems and the differential equation	ons, which describe	them. Students
	gave an overview of different solution approac	hes and for which kind of problems they can	be used for.	
Chille	Chudente ere able te calue different technical r	vehices with the introduced discretization	a a tha a da	
SKIIIS	Students are able to solve different technical p	problems with the introduced discretization m	nethods.	
Personal Competence				
Social Competence	The students are able to discuss problems and	jointly develop solution strategies.		
A				
Autonomy	The students are able to develop solution strat	egies for complex problems self-consistent a	and critically analyse	results.
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical En	gineering, Focus Th	eoretical Mechani
Following Curricula	Engineering: Compulsory			
	Engineering Science: Core Qualification: Comp	ulsory		
	General Engineering Science (English program, 7 semester): Core Qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical			
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation Theore	tical Mechanical Engineering: Elective Comp	ulsory	
	Mechanical Engineering: Specialisation Theore	tical Mechanical Engineering: Compulsory		
	Technomathematics: Specialisation III. Engine	ering Science: Elective Compulsory		

ourse 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. Alexander Düster, Prof. Robert Seifried, Prof. Thomas Rung	
Language	EN	
Cycle	SoSe	
Content	 Partial Differential Equations in technical problems Overview of modelling approaches Finite Approximation Methods - Finite Differences / Elements / Volumes Introduction to the Discrete Element Method Numerical methods for time dependent problems Gradient-based optimization 	
Literature	Michael Schäfer, Computational Engineering - Introduction to Numerical Methods, Springer.	

Module M0854: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Dif		Lecture	2	1
Differential Equations 2 (Partial Dif		Recitation Section (small)	1	1
Differential Equations 2 (Partial Dif Complex Functions (L1038)	lefential Equations) (E1045)	Recitation Section (large) Lecture	2	1
Complex Functions (L1030)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof Anusch Taraz			
Admission Requirements				
Recommended Previous	Mathematics 1 - III			
Knowledge				
	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge	 Students can name the basic concents in 	Mathematics IV. They are able to explain ther	n using appropri	ato oxamplos
	-	between these concepts. They are capable	or muscrating th	ese connections wi
	the help of examples.			
	 They know proof strategies and can repr 	oduce them.		
Skills		matics N/ with the belo of the concents studie	d in this source	Managuan they a
		natics IV with the help of the concepts studie	ea in this course	. Moreover, they a
	capable of solving them by applying esta			
		further logical connections between the conce		
		develop and execute a suitable approach, a	nd are able to c	ritically evaluate t
	results.			
Personal Competence				
Social Competence				
Social competence		ms. They are capable to use mathematics as a	a common langu	age.
	In doing so, they can communicate new	concepts according to the needs of their coop	erating partners	. Moreover, they c
	design examples to check and deepen th	e understanding of their peers.		
Autonomy				
Autonomy		inderstanding of complex concepts on their o	wn. They can sp	ecify open questio
	precisely and know where to get help in	solving them.		
	Students have developed sufficient pers	sistence to be able to work for longer period	s in a goal-orien	ted manner on ha
	problems.			
Werkleed in Hours	Independent Study Time CO. Study Time in Load	110		
	Independent Study Time 68, Study Time in Lect	ule 112		
Credit points	0			
Course achievement				
	None Written exam			
Examination		tial Equations 2)		
Examination	Written exam	tial Equations 2)		
Examination Examination duration and scale	Written exam	·	ring: Compulsor	y
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen	, 7 semester): Specialisation Electrical Enginee		-
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program	, 7 semester): Specialisation Electrical Enginee		-
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German progr	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica	l Engineering,	-
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture	Engineering,	Focus Mechatronic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture	Engineering,	Focus Mechatronio
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architectur , 7 semester): Specialisation Mechanical Engin	Engineering,	Focus Mechatronio
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architectur , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory	Engineering,	Focus Mechatronio
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architectur , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory	I Engineering, e: Compulsory leering, Focus Th	Focus Mechatronic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program,	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer	I Engineering, e: Compulsory leering, Focus Th ing: Compulsory	Focus Mechatronic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program,	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer	I Engineering, e: Compulsory leering, Focus Th ing: Compulsory	Focus Mechatronic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Compulsory	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T	Focus Mechatronic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineeri	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T	Focus Mechatronio
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Compulsory	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T	Focus Mechatronio
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineeri	7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica ,7 semester): Specialisation Naval Architecture ,7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T eering, Focus Th	Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp 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, Engineering: Compulsory	7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica ,7 semester): Specialisation Naval Architecture ,7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T eering, Focus Th	Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, Compulsory General Engineering Science (English program, Engineering: Compulsory Computational Science and Engineering: Specie	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin al semester): Specialisation Mechanical Engin and Mathematics & Engineering Science onics: Compulsory	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, I eering, Focus Th :: Elective Compu	Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, Compulsory General Engineering Science (English program, Engineering: Compulsory Computational Science and Engineering: Specialisation Mechatr	, 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin al semester): Specialisation Mechanical Engin and Mathematics & Engineering Science onics: Compulsory	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, I eering, Focus Th :: Elective Compu	Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic
Examination Examination duration and scale Assignment for the	Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp 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, Engineering: Compulsory Computational Science and Engineering: Special Mechanical Engineering: Specialisation Mechatr Mechanical Engineering: Specialisation Theoret	 7 semester): Specialisation Electrical Engineeram, 7 semester): Specialisation Mechanica 7 semester): Specialisation Naval Architecture, 7 semester): Specialisation Mechanical Engineral Mathematics: Elective Compulsory 7 semester): Specialisation Electrical Engineeram, 7 semester): Specialisation Mechanical Engineeram, 8 semester): Specialisation Mechanical Engineeram, 8 semester): Specialisation Mechanical Engineeram, 9 semester): Sp	I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, I eering, Focus Th :: Elective Compu	Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic

Course L1043: Differential Ec	quations 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 E	Course L1044: Differential Equations 2 (Partial Differential Equations)	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Course L1038: Complex Fund	tions
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
	 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 Func	tions
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.

Module M0933: Funda	amentals of Materials Science			
Courses				
Title Fundamentals of Materials Science Fundamentals of Materials Science	l (L1085) Il (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Typ Lecture Lecture	Hrs/wk 2 2	CP 2 2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements				
	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence	Arter taking part successionly, students have reached the follow			
Knowledge	The students have acquired a fundamental knowledge on a comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. T for materials and can identify relevant approaches for cha phenomena back to the underlying physical and chemical laws	cally the issues of ator he students know abo aracterizing specific p	nic structure, microstructor ut the key aspects of char	ure, phase diagrai acterization meth
Skills	The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stree resistance, and to phase transformations such as solidification between processing conditions and the materials microstruct material's behavior.	ngth, ductility, and st	iffness, chemical properti nelting. The students can	es such as corros explain the relat
Personal Competence				
Social Competence	-			
Autonomy	-			
	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
-				
	Written exam			
Examination duration and				
examination duration and scale	180 mm			
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S 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: Cor General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester): S Mechanical Engineering: Core Qualification: Compulsory	pecialisation Biomedia pecialisation Energy a pecialisation Naval Ar pecialisation Naval Ar pecialisation Energy ar pecialisation Mechanic pecialisation Naval Arc pecialisation Biomedic pecialisation Naval Arc	cal Engineering: Compulso and Enviromental Engineer chitecture: Compulsory chitecture: Compulsory and Enviromental Engineerin al Engineering: Compulsory al Engineering: Compulsory	ry 'ing: Compulsory ng: Compulsory ry
	Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Ele	ective Compulsory		

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 P. Haasen: Physikalische Metallkunde. Springer 1994

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 (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	Тур		Hrs/wk	СР
Computer Engineering (L0321)	Lecture		3	4
Computer Engineering (L0324)	Recitatio	on Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous				
Knowledge				
	After taking part successfully, students have reached the following learning	ng results		
Professional Competence		an average. It covers th	ha lavara fran	
Knowledge	P This module deals with the foundations of the functionality of computing programming down to gates. The module includes the following topics:	ig systems. It covers th	ne layers from	the assembly-le
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boolean functions, ha	-	binational netw	orks
	 Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations 			
	Computer arithmetic: Integer addition, subtraction, multiplication a	and division		
	Basics of computer architecture: Programming models, MIPS single		elining	
	Memories: Memory hierarchies, SRAM, DRAM, caches			
	Input/output: I/O from the perspective of the CPU, principles of pas	sing data, point-to-poin	t connections,	busses
Skills	The students perceive computer systems from the architect's perspective	e. i.e., they identify the	internal structu	ure and the physi
	composition of computer systems. The students can analyze, how highly			
	collection of few and simple components. They are able to distinguish b			
	today's computing systems - from gates and circuits up to complete proc	essors.		
	After successful completion of the module, the students are able to jud	dae the interdependent	ries between a	physical compu
	system and the software executed on it. In particular, they shall underst			
	on the hardware-centric abstraction layers from the assembly language			
	the impact that these low abstraction levels have on an entire system's p	erformance and to prop	ose feasible op	otions.
Personal Competence				
	Students are able to solve similar problems alone or in a group and to pre	esent the results accord	inaly	
Social competence	students are usie to solve similar problems alone of ma group and to pre	sent the results accord	iligiy.	
Autonomy	Students are able to acquire new knowledge from specific literature and t	to associate this knowle	dge with other	classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	Compulsory Bonus Form Description			
	Yes 10 % Excercises			
	Written exam			
Examination duration and scale	90 minutes, contents of course and labs			
	 General Engineering Science (German program, 7 semester): Specialisati 	on Computer Science: (ompulsory	
	General Engineering Science (German program, 7 semester): Specialisati			v
· · · · · · · · · · · · · · · · · · ·	General Engineering Science (German program, 7 semester): Specialisati			,
	General Engineering Science (German program, 7 semester): Specialisati	on Electrical Engineerin	g: Compulsory	
	General Engineering Science (German program, 7 semester): Specialisati	on Biomedical Engineer	ing: Compulsor	У
	General Engineering Science (German program, 7 semester): Specialisati	on Energy and Envirom	ental Engineeri	ng: Compulsory
	General Engineering Science (German program, 7 semester): Specialisati	on Process Engineering	: Compulsory	
	General Engineering Science (German program, 7 semester): Speci	alisation Mechanical E	Engineering, Fo	ocus Mechatron
	Compulsory General Engineering Science (German program, 7 semester): Speci-	alisation Mechanical E	ngineering, Fo	ocus Biomechani
	Compulsory		5 5, .	
	General Engineering Science (German program, 7 semester): Special	isation Mechanical Eng	gineering, Focu	ıs Aircraft Syste
	Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Spec	ialisation Mechanical	Engineering,	Focus Materials
	Engineering Sciences: Compulsory	ion Mochanical Enginee	ring Focus The	aratical Machani
	General Engineering Science (German program, 7 semester): Specialisati	on Mechanical Enginee	nng, rocus The	orerical Mechani
	Engineering: Compulsory		erina Focus Pr	oduct Developm
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisal	tion Mechanical Engine		ouuce Developin
		tion Mechanical Engine	ening, rocus ri	
	General Engineering Science (German program, 7 semester): Specialisat	-	-	·
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory	isation Mechanical Eng	ineering, Focu	s Energy Syster
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory	isation Mechanical Eng	ineering, Focu	s Energy Syster
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis	isation Mechanical Eng isation Mechanical Eng	ineering, Focu	s Energy Syster
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory	isation Mechanical Eng isation Mechanical Eng	ineering, Focu	s Energy Syster
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialisati	isation Mechanical Eng isation Mechanical Eng	ineering, Focu	s Energy Syste
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Specialisati Computer Science: Core Qualification: Compulsory	isation Mechanical Eng isation Mechanical Eng	ineering, Focu	s Energy Syste
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Specialisati General Engineering: Core Qualification: Specialisati	isation Mechanical Eng isation Mechanical Eng on Civil Engineering: Co	ineering, Focu ineering, Focu ompulsory g: Compulsory	s Energy Syste
	General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Specialisati Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory	isation Mechanical Eng isation Mechanical Eng on Civil Engineering: Co on Electrical Engineering on Civil Engineering: Cor	ineering, Focu ineering, Focu impulsory g: Compulsory npulsory	s Energy System

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	Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
C	Compulsory
G	Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
C	Compulsory
G	Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
E	ingineering: Compulsory
G	Seneral 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
a	and Production: Compulsory
G	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
E	Ingineering: 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
C	Computational Science and Engineering: Core Qualification: Compulsory
Μ	Aechatronics: Core Qualification: Compulsory
Т	echnomathematics: Specialisation II. Informatics: Elective Compulsory

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

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 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 comple	ex problems self-consistent and	crtically analyse	results.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): 9	Specialisation Mechanical Engine	eering: Compulso	iry
Following Curricula	General Engineering Science (German program, 7 semester): S			
-	General Engineering Science (German program, 7 semester): S	Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: 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 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/EN
Cycle	SoSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	 the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg.

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

Courses					
Title		Тур	Hrs/wk	СР	
	al Mechanics, Numerical Mechanics) (L1137)	Lecture	3	3	
	al Mechanics, Numerical Mechanics) (L1138) al Mechanics, Numerical Mechanics) (L1139)	Recitation Section (small) Recitation Section (large)	2 1	2 1	
		Recitation Section (large)	T	T	
Module Responsible					
Admission Requirements					
	Mathematics I-III and Mechanics I-III				
Knowledge	After teleing part successfully, students have reached t				
Educational Objectives Professional Competence	After taking part successfully, students have reached t	le following learning results			
-	The students can				
Knowledge					
	 describe the axiomatic procedure used in mecha 	nical contexts;			
	 explain important steps in model design; 				
	 present technical knowledge. 				
Skills	The students can				
	 explain the important elements of mathematication and their own problemes. 	I / mechanical analysis and model for	mation, and appl	y it to the context	
	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. 				
	• estimate the reach and boundaries of the metho	us and extend them to be applicable of	o wider problem	5005.	
Personal Competence					
	The students can work in groups and support each oth	er to overcome difficulties			
boelar competence					
Autonomy	Students are capable of determining their own strengt	is and weaknesses and to organize the	ir time and learn	ing based on those	
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 program, 7 sem	ester): Specialisation Mechanical Engin	eering: Compuls	ory	
Following Curricula	General Engineering Science (German program, 7 sem	ester): Specialisation Biomedical Engin	eering: Compulso	ory	
	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architectur	e: Compulsory		
	Energy Systems: Technical Complementary Course Con	e Studies: Elective Compulsory			
	General Engineering Science (English program, 7 seme	ster): Specialisation Mechanical Engine	ering: Compulso	ry	
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory				
	General Engineering Science (English program, 7 seme	ster): Specialisation Biomedical Engine	ering: Compulso	ry	
	Mechanical Engineering: Core Qualification: Compulsory				
	Mechatronics: Core Qualification: Compulsory				
	Naval Architecture: Core Qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Sci	ence: Elective Compulsory			
	Theoretical Mechanical Engineering: Technical Comple	nentary Course Core Studies: Elective	Compulsory		
Course L1137: Mechanics IV	(Oscillations, Analytical Mechanics, Numerical Me	chanics)			
Тур	Lecture				
Hrs/wk					
СР					
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42				
Lecturer	Prof. Robert Seifried				

Lecturer	Prof. Robert Seifried
Language	DE
Cycle	SoSe
Content	
	 Elements of vibration theory Vibration of Multi-degree of freedom systems Analytical Mechanics 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	(Oscillations, Analytical Mechanics, Numerical Mechanics)
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	(Oscillations, Analytical Mechanics, Numerical Mechanics)
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

See interlocking course

Literature See interlocking course

Content

Courses	
Title	Typ Hrs/wk CP
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 and functions of internal organs and the musculoskeletal system.
	The students can describe the basic macroscopy and microscopy of those systems.
Skills	The students can recognize the relationship between given anatomical facts and the development of some common diseases; th
	can explain the relevance of structures and their functions in the context of widespread diseases.
Personal Competence	
Social Competence	The students can participate in current discussions in biomedical research and medicine on a professional level.
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acqui
	the relevant knowledge themselves.
Mendels and In Harris	la desendent Chade Time C. Chade Time in Lecture 20
	Independent Study Time 62, Study Time in Lecture 28
Credit points Course achievement	
	Written exam
Examination Examination duration and	
	90 minutes
scale	Constal Engineering Science (Corman program, 7 constant), Specialization Biomedical Engineering, Computerny
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory

rse L0384: Introduction t	to Anatomy		
Тур	ecture		
Hrs/wk			
СР			
	dependent Study Time 62, Study Time in Lecture 28		
	Prof. Tobias Lange		
Language			
	SoSe General Anatomy		
Content	1 st week: The Eucaryote Cell		
	2 rd 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		
	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	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, studen	ts have reached the following learning results			
Professional Competence					
Knowledge					
	The students can distinguish different	t types of currently used equipment with respect	to its use in radiation the	erapy.	
	The students can explain treatment p	plans used in radiation therapy in interdisciplinary	y contexts (e.g. surgery,	internal medicine).	
	The students can describe the pa	tients' passage from their initial admittanc	e through to follow-up	o care.	
	Diagnostics				
	The students can illustrate the techn	nical base concepts of projection radiography, ir	ncluding angiography an	d mammography	
	well as sectional imaging techniques		iciduling anglography and	a manniography, s	
	The students can explain the diagnost techniques.	stic as well as therapeutic use of imaging techni	iques, as well as the tech	nical basis for the	
	The students can choose the right tre	eatment method depending on the patient's clinic	cal history and needs.		
	The student can explain the influence	e of technical errors on the imaging techniques.			
	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 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 inc groups, self-help groups, social servic	dividual psychosocial service should look like (ces, psycho-oncology).	e.g. follow-up treatment	:, sports, social he	
	Diagnostics				
	The students can suggest solutions for	or repairs of imaging instrumentation after having	g done error analyses.		
	The students can classify results of	imaging techniques according to different grou	ups of diseases based or	n their knowledge	
	anatomy, pathology and pathophysio				
Personal Competence					
Social Competence		social situation of tumor patients and interact wit ecial, often fear-dominated behavior of sick pe			
	measures and can meet them approp		opic cuused by diagno.	stie und therapeu	
Autonomy	The students can apply their new kno	wledge and skills to a concrete therapy case.			
, laconomy	The students can introduce younger s				
	The students are able to access anat	tomical knowledge by themselves, can participa	ate competently in conve	rsations on the tor	
	and acquire the relevant knowledge t				
Workload in Hours	Independent Study Time 62, Study Ti	me in Lecture 28			
Credit points					
Course achievement	None				
Examination					
Examination duration and scale	90 minutes				
	General Engineering Science (Germar	n program, 7 semester): Specialisation Biomedica	al Engineering: Compulso	ory	
Following Curricula	General Engineering Science (Gern	nan program, 7 semester): Specialisation Me	chanical Engineering, F	[;] ocus Biomechanic	
	Compulsory	. Computer r			
	Data Science: Specialisation Medicine Electrical Engineering: Specialisation	e: Compulsory Medical Technology: Elective Compulsory			
	Engineering Science: Specialisation B				
		ish program, 7 semester): Specialisation Me	chanical Engineering, F	ocus Biomechanic	
	Compulsory General Engineering Science (English	program, 7 semester): Specialisation Biomedica	al Engineering: Compulse	rv	
		program, 7 semester): Specialisation Biomedica			
	-				
	Mechanical Engineering: Specialisatio	on Biomechanics: Compulsory			

Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L0383: Introduction t	to Radiology and Radiation Therapy
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28 Prof. Ulrich Carl, Prof. Thomas Vestring
Language	
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	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	None			
Recommended Previous	Mathematik I + II for Engineering Students (german	or english) or Analysis & Linear Al	aebra I + II for Te	chnomathematic
Knowledge	basic MATLAB/Python knowledge			
	After taking part successfully, students have reached the for	bllowing learning results		
Professional Competence				
Knowleage	Students are able to			
	 name numerical methods for interpolation, integration 	on, least squares problems, eigenv	value problems, r	onlinear root fin
	problems and to explain their core ideas,			
	 repeat convergence statements for the numerical me 			
	 explain aspects for the practical execution of numeri 	cal methods with respect to comp	utational and sto	rage complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical methods up 	ising MATLAB/Python,		
	 justify the convergence behaviour of numerical methods 	nods with respect to the problem a	nd solution algori	thm,
	 select and execute a suitable solution approach for a 	given problem.		
Personal Competence				
•	Students are able to			
boelar competence				
	work together in heterogeneously composed teams	(i.e., teams from different study p	rograms and bac	kground knowled
	explain theoretical foundations and support each oth	ner with practical aspects regarding	g the implementa	tion of algorithm
Autonomy	Students are capable			
	 to assess whether the supporting theoretical and pra 		individually or in	i a team,
	 to assess their individual progess and, if necessary, t 	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			
Examination duration and	90 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7 semester	r): Specialisation Computer Science	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7 ser	mester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semester			
	General Engineering Science (German program, 7 sem	lester): Specialisation Mechanica	I Engineering, F	ocus Biomecha
	Compulsory General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engi	peering Focus Th	enetical Mecha
	Engineering: Compulsory	ry. specialisation mechanical Engli	leening, rocus m	leoretical meena
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical	Engineerina. Foc	us Aircraft Syst
	Engineering: Elective Compulsory		3, 00	
	General Engineering Science (German program, 7 semeste	r): Specialisation Mechanical Engi	neering, Focus M	echatronics: Elec
	Compulsory	. 5	-	
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical I	Engineering, Foc	us Energy Syste
	Elective Compulsory			
		ess Engineering: Elective Compulse	ory	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat	ics: Elective Compulsory		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir	ics: Elective Compulsory		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory	ics: Elective Compulsory neering Science: Elective Compulso		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls	ics: Elective Compulsory neering Science: Elective Compulso		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory	ics: Elective Compulsory neering Science: Elective Compulso		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory	ics: Elective Compulsory neering Science: Elective Compulso ory		
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester)	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory	bry	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester)	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science	ry : Compulsory	OCUS Riomacha
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester)	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science	ry : Compulsory	ocus Biomecha
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 sem Compulsory	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanica	ory : Compulsory I Engineering, F	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, Compulsory General Engineering Science (English program, 7 semester,	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanica	ory : Compulsory I Engineering, F	
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 sem Compulsory	ics: Elective Compulsory neering Science: Elective Compulsor ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engine	ory : Compulsory I Engineering, F eering, Focus Mat	erials in Enginee
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, Sciences: Compulsory	ics: Elective Compulsory neering Science: Elective Compulsor ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engine	ory : Compulsory I Engineering, F eering, Focus Mat	erials in Enginee
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, Sciences: Compulsory General Engineering Science (English program, 7 semester, Sciences: Compulsory General Engineering Science (English program, 7 semester, Sciences: Compulsory	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engin	: Compulsory I Engineering, F eering, Focus Mat eeering, Focus Th	eerials in Enginee eoretical Mecha
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester) Sciences: Compulsory General Engineering Science (English program, 7 semester) Sciences: Compulsory	ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engine r): Specialisation Mechanical Engine	: Compulsory I Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso	erials in Enginee eoretical Mecha Y

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Ma	thematics I					
Тур	Lecture					
Hrs/wk	2					
CP						
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28					
Lecturer	Prof. Sabine Le Borne					
Language	EN					
Cycle	WiSe					
Content	 Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature 					
Literature	 Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer 					

Course L0418: Numerical Ma	thematics 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		
Heat Transfer (L0458)		Lecture	3	4		
Heat Transfer (L0459)		Recitation Section (large)	2	2		
Module Responsible	Dr. Andreas Moschallski					
Admission Requirements	None					
Recommended Previous	Technical Thermodynamics I, II and Fluid Dynamics					
Knowledge						
,	After taking part successfully, students have reached th	e following learning results				
Professional Competence						
Knowledge	The students are able to					
	- describe the different physical mechanism of Heat Tra	nsfer,				
	- explain the technical terms,					
	- to analyse comlex heat 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 groups.					
Personal Competence						
	The students are able to discuss in small groups and de	velop an approach.				
Autonomy	The students are able to develop a complex problem se	If-consistent and analyse the results i	n a critical way.	A qualified exchar		
	with other students is given.	·····	· · · · · ,	1		
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 min					
scale						
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical	Engineering, Foc	us Energy Syster		
Following Curricula	Compulsory					
	General Engineering Science (German program, 7 seme	ster): Specialisation Biomedical Engin	eering: Compulso	ory		
	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engin	neering, Focus Th	neoretical Mechani		
	Engineering: Compulsory					
	Energy Systems: Technical Complementary Course Core	Studies: Elective Compulsory				
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical I	Engineering, Foc	us Energy Syster		
	Compulsory		-			
	General Engineering Science (English program, 7 semes	ter): Specialisation Biomedical Engine	ering: Compulso	ry		
	Mechanical Engineering: Specialisation Energy Systems					
	Mechanical Engineering: Specialisation Theoretical Mech		orv			

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

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

Courses								
Title				ту	/p		rs/wk	СР
Practical Course: Measurement and Control Systems (L1119)				actical Course	2		2	
Measurement Technology for Mechanical Engineering (L1116) Measurement Technology for Mechanical Engineering (L1118)					cture	2		3
		18)		Re	citation Section (larg	e) 1		1
Module Responsible								
Admission Requirements								
Recommended Previous	Basic knowledge of p	hysics, chemist	try and electrica	al engineering				
Knowledge								
Educational Objectives	After taking part succ	cessfully, stude	nts have reache	ed the following	learning results			
Professional Competence								
Knowledge	Students are able to Calibration, Static ar					hnology (Qua	ntities and	l Units, Uncerta
	They can outline the	most importa	nt measuring m	nethods for diffe	rent kinds of quant	ities to be m	aesured (E	Electrical Quant
	Temperature, mecha							
	They can describe im	portant metho	ds of chemical A	Analysis (Gas Se	nsors, Spectroscopy	, Gas Chroma	itography)	
Skills	Students can select s	uitable measur	ing methods to	given problems	and can use referin	g measureme	ent devices	in practice.
	The students are able	e to orally expl	ain issues in the	e subject area c	f measurement tec	hnology and s	solution ap	proaches as w
	place the issues into	the right conte	xt and application	on area.				
Personal Competence								
•	Students can arrive a	t work results i	n arouns and de	ocument them in	a common report			
,								
Autonomy	Students are able to	familiarize ther	nselves with new					
				w measurement				
Workload in Hours	Independent Study T			w measurement				
Workload in Hours Credit points	Independent Study T		Time in Lecture	w measurement e 70				
Workload in Hours	Independent Study T	ime 110, Study Form	Time in Lecture	w measurement				
Workload in Hours Credit points	Independent Study T 6 Compulsory Bonus	ime 110, Study Form	Time in Lecture	w measurement e 70				
Workload in Hours Credit points Course achievement	Independent Study T 6 Compulsory Bonus Yes None	ime 110, Study Form Subject th practical wor	Time in Lecture eoretical and k	w measurement e 70				
Workload in Hours Credit points Course achievement Examination	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an	ime 110, Study Form Subject th practical wor	Time in Lecture eoretical and k	w measurement e 70				
Workload in Hours Credit points Course achievement Examination	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an	ime 110, Study Form Subject th practical wor	Time in Lecture eoretical and k	w measurement e 70				
Workload in Hours Credit points Course achievement Examination Examination duration and scale	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes	Form Subject th practical wor	Time in Lecture eoretical and k rk	w measurement 9 70 Description	technologies.	Engineering	Compulso	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering	Form Subject th practical wor nd practical wo	Time in Lecture eoretical and k rk an program, 7 so	w measurement 2 70 Description emester): Specia	technologies.			
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering	Form Subject th practical wor nd practical wo Science (Germa Science (Germa	Time in Lecture eoretical and k rk an program, 7 so an program, 7 so	w measurement 9 70 Description emester): Specia emester): Specia	technologies.	Engineering:	Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering General Engineering	Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa	Time in Lecture eoretical and k rk an program, 7 so an program, 7 so an program, 7 so	w measurement e 70 Description emester): Specia emester): Specia emester): Specia	technologies.	Engineering:	Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering General Engineering Digital Mechanical En	Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa Science (Germa	Time in Lecture eoretical and k rk an program, 7 so an program, 7 so an program, 7 so an program, 7 so an program, 7 so	w measurement	technologies.	Engineering:	Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm	Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa Science (Germa	Time in Lecture eoretical and k rk an program, 7 sc an pr	w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls	technologies.	Engineering:	Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science:	Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation	Time in Lecture eoretical and k rk an program, 7 sc an pr	w measurement	technologies.	Engineering:	Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science:	Form Subject th practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation	Time in Lecture eoretical and k rk an program, 7 sc an pr	w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls compulsory ineering: Compu	technologies.	Engineering:	Compulso	ry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science:	Form Subject th practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si an program, 7 si a Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Engi	w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv	technologies.	Engineering: I Enviromenta	Compulso al Engineer	ry ing: Compulsor
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering	Form Subject th practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si e Qualification: (ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Engi h program, 7 se	w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv emester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisoty and	Engineering: Enviromenta	Compulso al Engineer Engineerin	ry ing: Compulsor ng: Compulsory
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering	Form Subject th practical wor nd practical wor difference (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a Qualification: (ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 se h program, 7 se	w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia Compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv emester): Specia emester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Energy and lisation Mechanical	Engineering: Enviromenta Enviromental Engineering:	Compulso al Engineer Engineerin Compulsor	ry ing: Compulsor ng: Compulsory Y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering	Form Subject th practical wor nd practical wor difference (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a Qualification: (ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 se h program, 7 se	w measurement 2 70 Description Description emester): Specia emester): Specia compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv :mester): Specia :mester): Specia :mester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Mechanical lisation Biomedical	Engineering: I Enviromental Enviromental Engineering: Engineering:	Compulso Il Engineerin Engineerin Compulsor Compulsor	ry ing: Compulsor ng: Compulsory Y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering	Form Subject th practical wor nd practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 si h program, 7 si h program, 7 si h program, 7 si	w measurement 2 70 Description Description emester): Specia emester): Specia compulsory ication: Compuls compulsory ineering: Electiv emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Mechanical lisation Biomedical lisation Mechatronica	Engineering: Enviromental Engineering: Engineering: S:: Compulsor	Compulso I Engineeri Compulsor Compulsor Y	ry ing: Compulsor ng: Compulsory y y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering	Form Subject th practical wor nd practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 si h program, 7 si	w measurement 2 70 Description Description demester): Specia emester): Specia emester): Specia compulsory incering: Electiv emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Mechanical lisation Biomedical lisation Mechatronical lisation Mechanical	Engineering: Enviromental Engineering: Engineering: S: Compulsor Engineering:	Compulso al Engineerin Compulsor Compulsor y Compulsor y	ry ing: Compulsor ng: Compulsory y y y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering	Form Subject th practical wor nd practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng biomedical Eng h program, 7 se h program, 7 se	w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Compul- incering: Compul- incering: Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisotion Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical	Engineering: Enviromental Engineering: Engineering: Compulsor Engineering: Engineering:	Compulso al Engineerin Compulsor Compulsor y Compulsor y	ry ing: Compulsor ng: Compulsory y y y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering	Form Subject th practical wor and practical wor and practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng h program, 7 si h program, 7 si	w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Compul- compulsory incering: Compul- incering: Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia mester): Specia mester): Specia mester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisotion Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical	Engineering: Enviromental Engineering: Engineering: Compulsor Engineering: Engineering:	Compulso al Engineerin Compulsor Compulsor y Compulsor y	ry ing: Compulsor ng: Compulsory y y y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Contral Engineering Contral Engineering Contral Engineering	Form Subject th practical wor and practical wor and practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng Biomedical Eng h program, 7 si h program, 7 si	w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Compul- compulsory incering: Compul- incering: Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia mester): Specia mester): Specia mester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisotion Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical	Engineering: Enviromental Engineering: Engineering: Compulsor Engineering: Engineering:	Compulso al Engineerin Compulsor Compulsor y Compulsor y	ry ing: Compulsor ng: Compulsory y y y
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering	Form Subject th practical wor and practical wor and practical wor science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis	Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng Biomedical Eng h program, 7 si h pro	w measurement 2 70 Description Description Description demester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Electiv emester): Specia emester): Specia	technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisation Energy and lisation Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical rocesses: Elective C	Engineering: Enviromental Engineering: Engineering: S: Compulsor Engineering: Engineering: Engineering: Compulsory	Compulso al Engineeri Compulsor Compulsor Y Compulsor Elective Co	ry ing: Compulsor ng: Compulsory y y y mpulsory

	rse: 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 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
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, students	have reached the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe basic biomolecules; 			
	explain how genetic information	is coded in the DNA;		
	explain the connection between	DNA and proteins;		
Chille	The students can			
SKIIIS	The students can			
	 recognize the importance of mo 	lecular parameters for the course of a disease;		
	 describe selected molecular-dia 	gnostic procedures;		
	 explain the relevance of these p 	rocedures for some diseases		
Personal Competence				
	The students can participate in discuss	sions in research and medicine on a technical leve	el.	
Autonomy	The students can develop understandi	ng of topics from the course, using technical liter	ature, by themselves.	
Workload in Hours	Independent Study Time 62, Study Tim	ne 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 Biomedical	Engineering: Compulso	ry
Following Curricula	General Engineering Science (Germa	an program, 7 semester): Specialisation Mech	hanical Engineering, Fo	ocus Biomechani
	Compulsory			
	Data Science: Specialisation Medicine:	Compulsory		
	Electrical Engineering: Specialisation M	ledical Technology: Elective Compulsory		
	Engineering Science: Specialisation Bio	omedical Engineering: Compulsory		
	General Engineering Science (English p	program, 7 semester): Specialisation Biomedical B	Engineering: Compulsor	У
	General Engineering Science (Englis	h program, 7 semester): Specialisation Mech	nanical Engineering, Fo	ocus Biomechani
	Compulsory			
	Mechanical Engineering: Specialisation	Biomechanics: Compulsory		
	Biomedical Engineering: Specialisation	Management and Business Administration: Elect	ive Compulsory	
	Biomedical Engineering: Specialisation	Artificial Organs and Regenerative Medicine: Ele	ctive Compulsory	
	Biomedical Engineering: Specialisation	Medical Technology and Control Theory: Elective	e Compulsory	
	Biomedical Engineering: Specialisation	Implants and Endoprostheses: Elective Compulse	ory	
	Technomathematics: Specialisation III.	Engineering Science: Elective Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Implants and Fracture Healing (L03	76)	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Introc	luction into Anatomie" before attending "Imp	lants and Fracture Heali	ing".
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	The students can describe the different wa	ays how bones heal, and the requirements fo	r their existence.	
	The students can name different treatmen	ts for the spine and hollow bones under give	n fracture morphologies	i.
Skills	The students can determine the forces act	ing within the human body under quasi-stati	c situations under speci	fic assumptions.
		5		,
Personal Competence				
Social Competence	The students can, in groups, solve basic n	umerical modeling tasks for the calculation o	f internal forces.	
Autonomy	The students can, in groups, solve basic n	umerical modeling tasks for the calculation o	f 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	program, 7 semester): Specialisation Mec	hanical Engineering, F	ocus Biomechani
Following Curricula	Compulsory			
	General Engineering Science (German pro	gram, 7 semester): Specialisation Biomedica	I Engineering: Compulso	ory
	Engineering Science: Specialisation Biome	dical Engineering: Compulsory		
		ram, 7 semester): Specialisation Biomedical		-
	General Engineering Science (English p	program, 7 semester): Specialisation Mec	hanical Engineering, F	ocus Biomechani
	Compulsory			
	Mechanical Engineering: Specialisation Bio	omechanics: Compulsory		
		plants and Endoprostheses: Elective Compuls	-	
	Biomedical Engineering: Specialisation Art	ificial Organs and Regenerative Medicine: Ele	ective Compulsory	
	Biomedical Engineering: Specialisation Ma	nagement and Business Administration: Elec	tive Compulsory	
	Biomodical Engineering , Engineering	dical Technology and Control Theory: Electiv	e Compulsory	
	biomedical Engineering. Specialisation Me	alcal rectificity and control meory. Electiv	compaisory	
	Orientation Studies: Core Qualification: Ele		compaisory	

ourse L0376: Implants and	Fracture Healing
Тур	Lecture
	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE
Cycle	WiSe
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
Embodiment Design and 3D-CAD (L	0268)		Lecture		2	1
Mechanical Design Project I (L0695				oblem-based Learning	3	2
Mechanical Design Project II (L0592				oblem-based Learning	3	2
Team Project Design Methodology				oblem-based Learning	2	1
Module Responsible	Prof. Dieter Krause					
Admission Requirements						
Recommended Previous	None					
	 Fundamentals 	s of Mechanical Engineering) Design			
Knowledge	 Mechanics 					
	 Fundamentals 	s of Materials Science				
	 Production En 	igineering				
	A.C					
Educational Objectives	After taking part suc	cessfully, students have re	ached the following learning	, results		
Professional Competence	A fter an end of the second					
Knowledge	After passing the mo	odule, students are able to:				
	 explain design 	n guidelines for machinery	parts e.g. considering load s	ituation, materials an	d manufactur	ing requirements
	 describe basic 	cs of 3D CAD,				
	 explain basics 	s methods of engineering d	esigning.			
Skills	After passing the mo	odule, students are able to:				
	 independently 	v create sketches. technica	I drawings and documentation	ons e.a. usina 3D CAD).	
		onents based on design gui	-		,	
		alculate) used components,	,,,			
			ering design tasks systamtic	ally and solution-orie	nted.	
	 use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. 					
		-,				
Personal Competence						
Social Competence	After passing the module, students are able to:					
	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups 					
	 present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 					
	· Teneet the ow	in the work group	s of the course.			
Autonomy	Students are able					
	 to optimate t 	hair laval of knowladga usi	a activating mothods withi	n the lectures (e.g. wi	ith 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 eligit 	neering design tasks system	natically.			
Workload in Hours	Independent Study	Time 40, Study Time in Lec	ture 140			
Credit points	6					
Course achievement		Form	Description			
	Yes None	Written elaboration	3D-CAD-Praktikum			
	Yes None	Written elaboration	Teamprojekt Konstruktio	onsmethodik		
	Yes None	Written elaboration	Konstruktionsprojekt 1			
	Yes None	Written elaboration	Konstruktionsprojekt 2			
Examination	Written exam					
Examination duration and	180					
scale						
Assignment for the	General Engineering	Science (German program	, 7 semester): Specialisatior	1 Mechanical Engineer	ring: Compuls	ory
Following Curricula			, 7 semester): Specialisation	-		-
	General Engineering	Science (German program	, 7 semester): Specialisatior	1 Biomedical Engineer	ing: Compuls	ory
	Digital Mechanical E	ngineering: Core Qualificat	on: Compulsory			
	Energy and Environr	mental Engineering: Core Q	ualification: Compulsory			
	Engineering Science	: Core Qualification: Comp	Ilsory			
	General Engineering	Science (English program,	7 semester): Specialisation	Biomedical Engineeri	ng: Compulso	ry
	Green Technologies	Energy, Water, Climate: S	pecialisation Energy Technol	logy: Elective Compul	sory	
	Mechanical Engineer	ring: Core Qualification: Co	mpulsory			
	Mechatronics: 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 De	esign 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 D	esign 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.

ourse L0267: Team Project	
,,	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
ntroduction into Medical Technolog	gy and Systems (L034	2)	Lecture	2	3
ntroduction into Medical Technolog	gy and Systems (L034	3)	Project Seminar	2	2
ntroduction into Medical Technolog	gy and Systems (L187	6)	Recitation Section (large)	1	1
Module Responsible	Prof. Alexander Sch	hlaefer			
Admission Requirements	None				
Recommended Previous	principles of math ((algebra, analysis/calculus)			
Knowledge	principles of stocha	astics			
	principles of progra	mming, R/Matlab			
Educational Objectives	After taking part si	ccessfully, students have reache	ed the following learning results		
Professional Competence					
-	The students can	explain principles of medical to	echnology, including imaging systems, c	omputer aided s	urgery and medi
Knowledge			view of regulatory affairs and standards in		
	internation system				-97
Skills	The students are al	ble to evaluate systems and med	dical devices in the context of clinical appl	ications.	
Personal Competence					
-	The students descr	ibe a problem in medical techno	logy as a project, and define tasks that an	e solved in a joint	effort.
				,	
Autonomy	The students can r	eflect their knowledge and docu	ment the results of their work. They can	present the resu	Its in an appropria
	manner.				
Workload in Hours	Independent Study	Time 110, Study Time in Lectur	e 70		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	Yes 10 %	Presentation			
	Yes 10 %	Written elaboration			
Examination	Written exam				
Examination duration and	90 minutes				
scale					
Assignment for the	General Engineerin	g Science (German program, 7 s	emester): Specialisation Biomedical Engir	eering: Compulso	ory
Following Curricula	Computer Science:	Specialisation Computer and So	ftware Engineering: Elective Compulsory		
			nd Engineering Science: Elective Compuls	ory	
		Qualification: Elective Compulse	•		
	Electrical Engineeri	ng: Core Qualification: Elective (Compulsory		
	Engineering Science	e: Specialisation Biomedical Eng	ineering: Compulsory		
	General Engineerin	g Science (English program, 7 se	emester): Specialisation Biomedical Engine	eering: Compulso	ry
	Computational Scie	ence and Engineering: Specialisa	tion II. Mathematics & Engineering Science	e: Elective Compu	ilsory
	Biomedical Enginee	ering: Specialisation Artificial Org	ans and Regenerative Medicine: Elective	Compulsory	
	Biomedical Enginee	ering: Specialisation Implants and	d Endoprostheses: Elective Compulsory		
	Biomedical Enginee	ering: Specialisation Medical Tec	hnology and Control Theory: Elective Com	pulsory	
	Biomedical Enginee	ering: Specialisation Managemen	t and Business Administration: Elective Co	ompulsory	

Course L0342: Introduction in	Course L0342: Introduction into Medical Technology and Systems		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Alexander Schlaefer		
Language	DE		
Cycle	SoSe		
Content	- 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 i	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	Focus 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 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	

ourses				
tle		Тур	Hrs/wk	СР
perimental Methods in Biomechar	nics (L0377)	Lecture	2	3
Module Responsible	Prof. Michael Morlock			
Admission Requirements	None			
Recommended Previous	It is recommended to participate in "Imp	lantate und Frakturheilung" before attending '	'Experimentelle Methode	en".
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students can describe the different v	vays how bones heal, and the requirements fo	or their existence.	
	The students can name different treatme	ents for the spine and hollow bones under give	en fracture morphologies	5.
	The students can describe different mea	surement techniques for forces and movemer	its, and choose the adec	uate technique fo
	given task.	·		
<i>ci "</i>				
SKIIIS	The students can describe the basic hand	dling of several experimental techniques used	in biomechanics.	
Personal Competence				
Social Competence	The students can, in groups, solve basic	experimental tasks.		
Autonomic	The students can, in groups, solve basic			
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	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
-		program, 7 semester): Specialisation Med	chanical Engineering, F	ocus Biomechani
Following Curricula				
		ogram, 7 semester): Specialisation Biomedica	I Engineering: Compulso	bry
	Engineering Science: Specialisation Biom	edical Engineering: Elective Compulsory		
		program, 7 semester): Specialisation Mec	hanical Engineering, F	ocus Biomechani
	Compulsory			
		ogram, 7 semester): Specialisation Biomedical		-
	General Engineering Science (English pro	ogram, 7 semester): Specialisation Biomedical	Engineering: Elective C	ompulsory
	Mechanical Engineering: Specialisation B	iomechanics: Compulsory		
	General Engineering Science (English pro General Engineering Science (English pro	ogram, 7 semester): Specialisation iomechanics: Compulsory	Biomedical	Biomedical Engineering: Elective C

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

Specialization Naval Architecture

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

Module M0730: Comp	outer Engineering			
Courses				
Title		Tun	Hrs/wk	СР
Computer Engineering (L0321)		Typ Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Drof Hoiko Falk			
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Knowledge				
-	After taking part successfully, students have reached the follo	owing 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 followi	ng topics:		
	Introduction			
	Combinational logic: Gates, Boolean algebra, Boolean 1	functions bardware synthesis cor	mbinational netw	vorks
	 Sequential logic: Flip-flops, automata, systematic hards 			Vorits
	Technological foundations	ware design		
	-	Itiplication and division		
	 Computer arithmetic: Integer addition, subtraction, mu Basics of computer architecture: Programming models, 		ipolining	
		, Mirs single-cycle architecture, p	ipenning	
	Memories: Memory hierarchies, SRAM, DRAM, caches Input/outputs I/O from the perception of the CRU, price	ciplos of passing data point to pa	int connections	huccoc
	Input/output: I/O from the perspective of the CPU, print	cipies of passing data, point-to-po	int connections,	busses
Skills	The students perceive computer systems from the architect's	perspective, i.e., they identify th	e internal struct	ure and the physical
	composition of computer systems. The students can analyze,	how highly specific and individua	al computers car	be built based on a
	collection of few and simple components. They are able to c			
	today's computing systems - from gates and circuits up to co	mplete processors.		
	After successful completion of the module, the students are	e able to judge the interdepende	ncies between a	a physical computer
	system and the software executed on it. In particular, they s	hall understand the consequence	s that the execu	ition of software has
	on the hardware-centric abstraction layers from the assembly	y language down to gates. This w	ay, they will be	enabled to evaluate
	the impact that these low abstraction levels have on an entire	e system's performance and to pro	opose feasible o	ptions.
Personal Competence				
	Chudonka are able to achue similar problems alone ar in a grou	and to present the results acces	und in out of	
Social Competence	Students are able to solve similar problems alone or in a grou	ip and to present the results accol	aingly.	
Autonomy	Students are able to acquire new knowledge from specific lite	erature and to associate this know	ledge with other	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
course achievement	Yes 10 % Excercises			
Examination	Written exam			
	90 minutes, contents of course and labs			
scale				
	General Engineering Science (German program, 7 semester):	Specialisation Computer Science	Compulsory	
-	General Engineering Science (German program, 7 semester):			rv.
r onowing curricula	General Engineering Science (German program, 7 semester):			y
	General Engineering Science (German program, 7 semester):	•		,
	General Engineering Science (German program, 7 semester):	1 5	5 1 5	
	General Engineering Science (German program, 7 semester):			-
	General Engineering Science (German program, 7 semester): General Engineering Science (German program, 7 semester):		-	ing. compulsory
	General Engineering Science (German program, 7 semester).			ocus Mochatronics:
		ster). Specialisation Mechanical	Lingineering, i	ocus mechacionics.
	Compulsory	stor). Creatilization Machanical		acus Diamashanisa
	General Engineering Science (German program, 7 semes	ster). Specialisation Mechanical	Engineering, F	beus biomechanics.
	Compulsory			Alizza fit. Constants
	General Engineering Science (German program, 7 semest	er, specialisation Mechanical E	igineering, roo	us Anciait Systems
	Engineering: Compulsory	sctor). Specialization Machaning	Engineering	Focus Matoriala
	General Engineering Science (German program, 7 seme	ssien, specialisation Mechanica	i Engineering,	i ocus materiais IN
	Engineering Sciences: Compulsory	Charing Machanism Tra	oring Factor	oprotical Mash-site
	General Engineering Science (German program, 7 semester):	specialisation Mechanical Engine	ering, Focus Th	euretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (German program, 7 semester)	: Specialisation Mechanical Engin	eering, Focus Pi	roauct Development
	and Production: Compulsory		–	
	General Engineering Science (German program, 7 semester	er): Specialisation Mechanical Er	igineering, Focu	is Energy Systems:
	Compulsory			_
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Er	ngineering, Focu	us Energy Systems:
l	Compulsory			I

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

Course L0321: Computer 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/EN	
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/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Hydro	ostatics and Body Plan			
Courses				
itle		Тур	Hrs/wk	СР
lydrostatics (L1260)		Lecture	2 2	3 1
lydrostatics (L1261) ody Plan (L1452)		Recitation Section (large) Project Seminar	2	2
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	Good knowledge in Mathemathics I-III and Mechanics I-III.			
Knowledge	It is recommended that the students are familiar with typi	cal design relevant drawings e.g. B	ody Plan GA- Pla	an Tank Plan etc
		car acolgi i relevane aratimigo, elgi o		
	After taking part successfully, students have reached the	following learning results		
Professional Competence	The lastice enclose the student to some suit all persons	, the excitical calculations for ship de	ainn an a caiont	if a lovel The lest
Knowledge	The lecture enables the student to carry out all necessar is basic requirement for all following lectures in the subject		esign on a scient	inc level. The lectu
	is busic requirement for an following rectares in the subject	to shipe design and safety of ships.		
Skills	The student is able to carry out hydrostatic calculations	to ensure that the ship has sufficie	ent stability. He i	s able to design hu
	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	Written exam			
Examination duration and	180 min			
scale				
	General Engineering Science (German program, 7 semest			
Following Curricula	General Engineering Science (German program, 7 semest General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste			
	Naval Architecture: Core Qualification: Compulsory			
Course L1260: Hydrostatics				
Тур	Lecture			
Typ Hrs/wk	2			
Typ Hrs/wk CP	2 3			
Typ Hrs/wk CP Workload in Hours	2 3 Independent Study Time 62, Study Time in Lecture 28			
Typ Hrs/wk CP Workload in Hours	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger			
Typ Hrs/wk CP Workload in Hours Lecturer	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE			
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE			
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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	tegration Methods		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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			
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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 Curve	-		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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	-		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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 Curve	-		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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 Curve - Heeling Moments of Different Type	es ter Ingress		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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 Curve - Heeling Moments of Free Surfaces, Water on Deck, Wa - Heeling Moments of Different Type - Balance of Heeling and Righting Moments acc. to BV 1	es ter Ingress		
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 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 In - 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 Curve - Heeling Moments of Free Surfaces, Water on Deck, Wa - Heeling Moments of Different Type	es ter Ingress		

- Linearization of Restoring Fo	rces and Moments
- Correlation between Metacer	ntric Height and Righting Lever at small heeling angles
- Computation of Path of Meta	centric Height for Modern Hull Forms
- Correlation between Righting	JLever and Path of Metacentric Height
- Hydrostatic Stiffness Matrix	
- Definition of MCT	
- Computation of Equilibrum F	loating Conditions from Hydrostatic Tables
- Effect of Free Surfaces on Ini	tial GM
- Roll Motions at Small Roll An	gles
6. Stability in Waves	
- Roll Motions at Large Amplitu	ıdes
- Pure Loss of Stability on the	Wave Crest
- Principle of Parametric Excita	ation
- Principle of Direct Wave Mon	nents
- Grim´s Equivalent Wave Con	cept
6 Longitudinal Strength	
- Longitudinal Mass Distributio	n, Shear Forces, Bending Moments
- Longitudinal Strength in Stat	ility Booklet
7. Deadweight Survey and Inclir	ing Experiment
- Deplacement Computations	from Draft mark Readings
- Weights to go on /come from	board
- Inclining Experiment with He	eling Moments from Weights and Heeling Tanks
- Residual Sounding Volumes	
- Determination of COG from N	Aetacentric height and from Cross Curves
- Roll Decay Test	
8. Launching and Docking	
- Launching Plan, Arrangemer	nt of Launching Blocks
- Rigid Body Launching: Tiltin	g, Dumping, Equation of Techel
- Computation of Launching E	vent
- Bottom Pressure and Longit	udinal Strength
- Linear- Elastic Effects	
- Transversal Stability on Slip	way and in Dock
9. Grounding	
- Loss of Buoynacy when Grou	nded
- Pointwise Grounding	
- Ship Grounds on Keel	
10. Introduction into Damage St	ability Problems
- Added Mass Method	
- Loss of Buoyant Volume Me	hod
- Simple Equilibrium Compute	tions
- Intermediate Stages of Floor	ding (Addes Mass Method), Cross- and Downflooding
- Water Ingress Through Oper	nings
11. Special Problems (optional a	nd agreed upon)
- e.g. Heavy Lift Operations	
- e.g. Jacking of Jackup Vesse	s
- e.g. Sinking After Water Ing	ress

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
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Krüger
Language	DE
Cycle	WiSe
Content	As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of : - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles.
Literature	 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				
		_		
Title Fundamentals of Materials Science	1 (11095)	Typ Lecture	Hrs/wk 2	CP 2
Fundamentals of Materials Science I (L1085) Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)		Lecture	2	2
Physical and Chemical Basics of Materials Science (L1095)		Lecture	2	2
Module Responsible				
Admission Requirements	None			
	Highschool-level physics, chemistry und mathematics			
Knowledge	righschool-ever physics, chemistry and 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 metals, ceramics and polymers and can describe this knowled comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagra phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization meti for materials and can identify relevant approaches for characterizing specific properties. They are able to trace mater phenomena back to the underlying physical and chemical laws of nature.			
Skills				
Personal Competence				
Social Competence	_			
Autonomy	-			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement				
	Written exam			
Examination duration and	180 min			
scale				
-	General Engineering Science (German program, 7 semester): S			-
Following Curricula	General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp			ing: Compulsory
	General Engineering Science (German program, 7 semester): Sp			
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Arcr	nitecture: Compulsory	
	Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory			
	Energy and Environmental Engineering: Core Qualification: Computering			
			Enviromental Engineeri	
			i Enviromentai Engineen	
	General Engineering Science (English program, 7 semester): Sp		Engineering: Computer	
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical		
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical ecialisation Naval Archi	itecture: Compulsory	ry
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical ecialisation Naval Archi ecialisation Biomedical	itecture: Compulsory Engineering: Compulsor	ry
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi	itecture: Compulsory Engineering: Compulsor	ŷ
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect	ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi	itecture: Compulsory Engineering: Compulsor	ry
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect Mechanical Engineering: Core Qualification: Compulsory	ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi	itecture: Compulsory Engineering: Compulsor	ry
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect	ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi	itecture: Compulsory Engineering: Compulsor	ŷ

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 P. Haasen: Physikalische Metallkunde. Springer 1994	

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
СР	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 M0854: Math	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Dif	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Dif	ferential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Dif	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 None			
Admission Requirements Recommended Previous				
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
	 Students can name the basic concepts in Math Students can discuss logical connections betw the help of examples. They know proof strategies and can reproduce 	ween these concepts. They are capable		
Skills	 Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they a 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 can develop and execute a suitable approach, and are able to critically evaluate th results. 			
Personal Competence Social Competence				
Autonomy	 Students are capable of checking their understanding of complex concepts on their own. They can specify open question precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on har problems. 			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 1	12		
Credit points	6			
Course achievement				
Examination				
Examination duration and	60 min (Complex Functions) + 60 min (Differential E	quations 2)		
scale				
Assignment for the	5 5 7 7 5 7			
Following Curricula	5 5 7 7 5 7	/ semester): Specialisation Mechanica	I Engineering,	Focus Mechatronic
	Compulsory			
	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se	emester): Specialisation Mechanical Engi	neering, Focus Tl	heoretical Mechanic
	Engineering: Elective Compulsory			
	Computer Science: Specialisation Computational Mat			
	Computer Science: Specialisation II. Mathematics and		ory	
	Electrical Engineering: Core Qualification: Compulsor	ТУ		
	Engineering Science: Specialisation Electrical Engine	ering: Compulsory		
	General Engineering Science (English program, 7 ser	mester): Specialisation Electrical Enginee	ring: Compulsory	/
	General Engineering Science (English program, 7 ser	mester): Specialisation Electrical Enginee	ring: Compulsory	/
	General Engineering Science (English program,	7 semester): Specialisation Mechanica	I Engineering,	Focus Mechatroni
	Compulsory			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical Engir	neering, Focus Ti	neoretical Mechani
	Engineering: Compulsory General Engineering Science (English program, 7 ser Computational Science and Engineering: Specialisati Mechanical Engineering: Specialisation Mechatronics	on II. Mathematics & Engineering Science		ulsory
	Mechanical Engineering: Specialisation Theoretical M		ory	
	Mechanical Engineering: Specialisation Theoretical M			
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
1	1			

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

ourse 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	
	 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 Fund	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 Fund	ourse 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	

Courses				
Title		Тур	Hrs/wk	СР
-	al Mechanics, Numerical Mechanics) (L1137)	Lecture	3	3
	al Mechanics, Numerical Mechanics) (L1138)	Recitation Section (small)	2	2
	al Mechanics, Numerical Mechanics) (L1139)	Recitation Section (large)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous	Mathematics I-III and Mechanics I-III			
Knowledge				
	After taking part successfully, students have reached	I the following learning results		
Professional Competence	The shudents con			
Knowledge	The students can			
	describe the axiomatic procedure used in mech	hanical contexts;		
	 explain important steps in model design; 			
	 present technical knowledge. 			
Skills	The students can			
	explain the important elements of mathematic	cal / mechanical analysis and model for	mation, and appl	y it to the context
	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. 			
	• estimate the reach and boundaries of the metr	nous and extend them to be applicable t	o wider problem	sets.
Personal Competence				
	The students can work in groups and support each of	ther to overcome difficulties		
Social competence	The students can work in groups and support each other to overcome difficulties.			
Autonomy	Students are capable of determining their own streng	gths and weaknesses and to organize the	eir time and learn	ing based on those
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	4		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 ser	mester): Specialisation Mechanical Engin	eering: Compuls	ory
Following Curricula	General Engineering Science (German program, 7 ser	mester): Specialisation Biomedical Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 ser	mester): Specialisation Naval Architectur	e: Compulsory	
	Energy Systems: Technical Complementary Course Co	ore Studies: Elective Compulsory		
	General Engineering Science (English program, 7 sem			ry
	General Engineering Science (English program, 7 sem			
	General Engineering Science (English program, 7 sem		eering: Compulso	ry
	Mechanical Engineering: Core Qualification: Compulso	ory		
	Mechatronics: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering So	cience: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Compl		Compulsory	
	Theoretical Prechanical Engineering. Technical Compl	construction studies. Elective	compaisory	
Course L1137: Mechanics IV	(Oscillations, Analytical Mechanics, Numerical M	lechanics)		
Тур				
Hrs/wk				
111 3/ WK				
CB	3			
CP Workload in Hours		2		
	Independent Study Time 48, Study Time in Lecture 42	2		

Language	DE
Cycle	SoSe
Content	
	 Elements of vibration theory Vibration of Multi-degree of freedom systems Analytical Mechanics 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	(Oscillations, Analytical Mechanics, Numerical Mechanics)
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	(Oscillations, Analytical Mechanics, Numerical Mechanics)
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

Content

SoSe

Literature See interlocking course

See interlocking course

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 n	nechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to expla Students can scientifically outline the rationale of flow physi performance analysis and the prediciton of fluid engineering	cs using mathematical models a		
Skills	Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lectur enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on scientific level.			
Personal Competence				
-	The students are able to discuss problems and jointly develop	o 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			
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 semester):	Specialisation Mechanical Engin	eering: Compulse	ory
Following Curricula			÷ .	-
	General Engineering Science (German program, 7 semester):			5
	General Engineering Science (English program, 7 semester):			ry
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):	Specialisation Biomedical Engine	ering: Compulsor	ТУ
	Computational Science and Engineering: Specialisation Engin	eering Sciences: Elective Compu	lsory	
	Mechanical Engineering: Core Qualification: Compulsory			
	Naval Architecture: Core Qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science: I	Elective Compulsory		

Course L0454: Fluid Mechan	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/EN
Cycle	SoSe
Content	 continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows)
Literature	 the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg.

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/EN	
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			
	None			
Recommended Previous Knowledge	Technical mechanicsLinear algebra, analysis, complex numbersFluid mechanics			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	- The students are able to give an overview over various manoeuvres. They can name application goals and they can describe t procedure of the manoeuvres.			
	- 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	ns in waves.	
Skills	Skills - The students can come up with the equations of motions which are used to discribe manoeuvres. The can use and lir - The students are able to determine hydrodynamic coefficients and they can explain their physical meaning.		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	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			
	General Engineering Science (German program, 7 sem	ester): Specialisation Naval Architectur	e: Compulson/	
Following Curricula	General Engineering Science (English program, 7 seme	•		
shing carricula	Naval Architecture: Core Qualification: Compulsory	, specialisation naval Architecture		

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
	Representation of harmonic processes
	Motions of a rigid ship in regular waves
	Flow forces on ship cross sections
	Strip method
	Consequences induced by ship motion in regular waves
	Behavior of ships in a stationary sea state
	Long-term distribution of seaway influences
Literature	
	 Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut f ür Fluiddynamik und Schiffstheorie, Technische Universit ät
	Hamburg-Harburg, 2014
	 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University of Technology, 2014
	• Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, United
	Kingdom, 2000
	 Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, Canada,1978 Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993
	 Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. 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, Jersey City, NJ, 1989
	Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004
	Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998
	<u> </u>

Course L1620: Ship Dynamic	urse 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		αγΤ	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 - I	I		
Educational Objectives	After taking part successfully, students	nave reached the following learning results		
Professional Competence				
-		ng as well as fabrication of the different areas of ship	o structures and o	f different ship typ
5		alculation models for complex structures.		
		on models and to assess the chosen structure		
Personal Competence				
Social Competence	Students are capable to present their st	ructural design and discuss their decisions construction	ively in a group.	
	Students are capable to design indepe	ndently different structural areas of the ship hull a	and different ship	types and to def
Autonomy				cypes and co act
Autonomy	appropriate fabrication methods.			
Autonomy	appropriate fabrication methods.			
Autonomy Workload in Hours		ie in Lecture 98		
Workload in Hours Credit points	Independent Study Time 172, Study Tim	ie in Lecture 98		
Workload in Hours Credit points Course achievement	 Independent Study Time 172, Study Time 9 None 	e in Lecture 98		
Workload in Hours Credit points Course achievement Examination	 Independent Study Time 172, Study Time 9 None Written exam 	e in Lecture 98		
Workload in Hours Credit points Course achievement Examination Examination duration and	 Independent Study Time 172, Study Time 9 None Written exam 3 hours 	ie in Lecture 98		
Workload in Hours Credit points Course achievement Examination Examination duration and scale	 Independent Study Time 172, Study Time 9 None Written exam 3 hours 			
Workload in Hours Credit points Course achievement Examination Examination duration and	 Independent Study Time 172, Study Time 9 None Written exam 3 hours General Engineering Science (German p 	ie in Lecture 98 rogram, 7 semester): Specialisation Naval Architectu ogram, 7 semester): Specialisation Naval Architectur		

Course L0412: Ship Structural Design		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sören Ehlers	
Language	DE	
Cycle	SoSe	
Content	Chapters:	
	 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 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 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 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		Typ	Hrs/wk	СР
Fundamentals of Ship Structural De	sign (10411)	Typ Lecture	2	2
Fundamentals of Ship Structural De	-	Recitation Section (small)	1	2
Fundamentals of Ship Structural Ar	-	Lecture	2	2
Fundamentals of Ship Structural Ar		Recitation Section (small)	1	2
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 - III			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students can reproduce the basic contents of t	he structural behaviour of ship structures; the	y can explain the	theory and metho
	for the calculation of deformations and stresse	s in beam-like structures.		
	Furthermore, they can reproduce the basis co	ntents of codes (rules), materials, semi-finish	ed products, join	ing and principles
	structural design of components in the ship str	ucture.		
Skills	Students are capable of applying the method	ds and tools for the calculation of linear def	ormations and s	tresses in the abo
	mentioned structures; they can choose calcula	tion models of typical ship structures.		
	Furthermore, they are capable to apply the m	ethods of drawing and sizing the ship structu	re; they can sele	ct suitable materia
	semi-finished products and joints.			
Personal Competence				
Social Competence	The students are able to communicate and c	ooperate in a professional environment in th	e shipbuilding ar	id component sup
	industry.			
Autonomy	The students are capable to independently id	ealize real ship structures and to select suita	ble methods for	analvsis of beam-li
2	structures; they are capable to assess the resu			,
		, , , , , , , , , , , , , , , , , , ,		
	Furthermore, they are capable to assess d	rawings of complex ship structures and to	design ship st	ructures for vario
	requirements and boundary conditions.			
Workload in Hours	Independent Study Time 156, Study Time in Lecture 84			
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	3 hours			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Naval Architectu	re: Compulsory	
Following Curricula	General Engineering Science (English program		1	
	Naval Architecture: Core Qualification: Comput			

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

Course L0413: Fundamentals of Ship Structural Design		
Тур	Recitation Section (small)	
Hrs/wk	1	
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 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

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		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			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	The hydrodynamic basics that are relevant for			
	phenomena and their practical applications to hull	-		
	of the course. Furthermore, environmental additio			
	their application to full scale ships. This hold also		-	
	Main Focus is how hull forms can be optimized for i	minimum and sustainable fuel consumption	. The following to	opics are dealt with
	- Stillwater/added resistance, Wave resistance, M	Ainimization of wave resistance, numerication	al prediction me	thods, friction law
	laminar/turbulent flow separation, Hull form desi	gn for redcude flow separation, Appenda	ge Design and	resistance, Froude
	resistance law,form factor method, thrust deduction	on, wake, model scaling laws, resistance t	ests, free running	g propeller tests a
	propeller basics, propulsion tests, full scale speed	power predictions, additional resistances	(wind, steering,	current, sea state
	EEDI, speed trials, contractual matters concerning	speed/power, bunker claims		
Skills	The student shall learn to design competitve hull f	forms with respect to fuel consumption by	applying numreic	al techniques and
Skiils	evaluate these hulls by several progosis metho			
	minimize the required power including environmen			
Personal Competence				
	The student learns to prepare technical matters in		-	
Autonomy	The student learns to prepare technical matters in	such a way that he can compte with his bu	ilding suvervisior	i team.
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
		anneater). Createlization Neural Architectur	Commulaon,	
Assignment for the	General Engineering Science (German program, 7 s	semester): Specialisation Naval Architectur	e: compulsory	

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

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

itle				
		Тур	Hrs/wk	CP
nip Design (L1262)		Lecture	2	3
nip Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Fluid Dynamics for Naval Architects, Resistant Resistance and Propulsion, Hydrostatics 	nce and Propulsion		
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The lecture starts with an overview about the imp Ship Designs are thoroughly discussed. Typical bulk main parameters of a ship are introduced and th influence of alternated main parameters on the to lecture, the design changes are dealt with by si systems properly so that the relavent technical con The lecture continues with an introduction into the contract. Further, methods are introduced to gene during the different design stages. In detail, the foll - Structure of a building specification - Determination of Light Ship Weight and Deadweig 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 members - Longitudinal strength - Outfitting Components	ding contracts and the related technical ris eir influence on the competitiveness of a tal performance of a ship design and the of mple models or formulae. The student s clusions can be drawn. e different phases of design project, from rate bulding specfication relevant informa lowing topics are adressed:	k are introduced. design. The lect consecutive proc shall further learn the initial design	The most importa ture focusses on t ess elements. In t in to model compl n phase to a buildi
	- Relevant rules and regulations			
Skills	The student is made familiar with the basic design student shall be able to carry out a concept design the Marine Environment. The lecture deals with the of a ship design with respect to fulfillment procedure relevant methods to determine and judge uppn the	based on a vessel of comparison fulfilling e basic design methods to determine the irres of the contract values. Based on the l	y typical contract fundamantal tech ecture "Principles	requirements with hnical characterist
Personal Competence				
Social Competence	The students learns to prepare technical matte	rs in such a way the he can persuade	his potantial c	ustomer against
Autonomy	competitors. The students learns to prepare technical matter competitors.	rs in such a way the he can persuade	his potantial c	ustomer against
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 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 s	semester): Specialisation Naval Architectur	e: Compulsory	
Following Curricula	General Engineering Science (English program, 7 se Naval Architecture: Core Qualification: Compulsory	emester): Specialisation Naval Architecture	e: Compulsory	

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

Course L1264: Ship Design	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 Proc	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	none				
Knowledge	A Constalling park average	Cities at sub-onto house you	1. The following loopping popula		
Educational Objectives	After taking part succes	ssfully, students nave rea	ached the following learning results		
Professional Competence	After passing this modu	le the students have the	ability to		
Kiloweage	After passing this modu	lle the students have the	ability to.		
			elds on process and bioprocess enginee ent fields in process engineering.	ring,	
Skills	 After passing this module the students should have the ability to: list and outline the most important fields of process engineering, name the most important working approaches or methods of the different fields of process engineering, read and prepare an engineering drawing, explain the most important technologies for wastewater and exhaust air treatment scheme typical chemical and biotechnological processes independently with the aid of pointers. 				
Personal Competence Social Competence	 The students are able to work out results in groups and document them, provide appropriate feedback and handle feedback on their own performance constructively. 				
Autonomy Workload in Hours	Engineering and Biopro-	cess Engineering.	ss of learning by themselves and to de	liberate their lack of k	nowledge in Process
Credit points	1	e 34, Study Time in Lect	ure 56		
Course achievement	<u> </u>	Form	Description		
course acmevement		Written elaboration			
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Sc	ience (German program,	7 semester): Specialisation Process Eng	ineering: Compulsory	
Following Curricula	General Engineering Sc	ience (German program,	7 semester): Specialisation Bioprocess	Engineering: Compulso	ry
	Bioprocess Engineering	: Core Qualification: Com	npulsory		
			7 semester): Specialisation Bioprocess E		у
			7 semester): Specialisation Process Engi	neering: Compulsory	
	-	Core Qualification: Election			
	Process Engineering: Co	ore Qualification: Compu	Isory		

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	s. StudIP

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

Courses	
Fitle	Typ Hrs/wk CP
Computer Engineering (L0321)	Lecture 3 4
Computer Engineering (L0324)	Recitation Section (small) 1 2
Module Responsible	Prof. Heiko Falk
	None
	Basic knowledge in electrical engineering
Knowledge	
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-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 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
	The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based of collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical compu- 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 evalue 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
	6
Course achievement	Compulsory Bonus Form Description Yes 10 % Excercises
Examination	
	90 minutes, contents of course and labs
scale	
Assignment for the	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 Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation 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 Biomechan 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 Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory Concrat Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
	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 Syster
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste

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	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
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	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/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title Fundamentals of Fluid Mechanics (I		Typ Lecture Recitation Section (large	Hrs/wk 2 2) 2	CP 4 2
Fluid Mechanics for Process Engine Module Responsible		Recitation Section (large	:) Z	Z
Admission Requirements				
Recommended Previous	None			
Knowledge	 Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial Integration 	differential equations		
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
	explain simplifications of the Contin	erent types of flow cations of the Reynolds Transport-Theorem in nuity- and Navier-Stokes-Equation by using ph		ions
Skills	 s The students are able to describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering 			
Personal Competence				
Social Competence Autonomy	 are capable to gather information f of the lecture and able to work together on subject re (e.g. during small group exercises) are able to work out solutions for ex The students are able to search further literature for each to 	rom subject related, professional publications elated tasks in small groups. They are able to kercises by themselves, to discuss the solution pic and to expand their knowledge with this li n and to evaluate their actual knowledge with	o present their results ns orally and to presen terature,	effectively in Engli
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	CompulsoryBonusFormYes5 %Midterm	Description		
Examination				
Examination duration and scale	3 hours			
Assignment for the	General Engineering Science (German pro	gram, 7 semester): Specialisation Process Eng	ineering: Compulsory	
Following Curricula	General Engineering Science (German pro General Engineering Science (German pro Bioprocess Engineering: Core Qualification Energy and Environmental Engineering: Co General Engineering Science (English prog	ore Qualification: Compulsory gram, 7 semester): Specialisation Bioprocess E gram, 7 semester): Specialisation Energy and	Enviromental Enginee nologies: Compulsory Engineering: Compulso Enviromental Engineer	ring: Compulsory

Course L0091: Fundamentals	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. 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
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		Lecture	2	2
Phase Equilibria Thermodynamics		Recitation Section (small)	1	2
Phase Equilibria Thermodynamics		Recitation Section (large)	1	Z
Module Responsible				
Admission Requirements	None			
	Mathematics, Physical Chemistry, Thermoo	lynamics I and II		
Knowledge				
Educational Objections				
	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	• Starting from the very basics of th	ermodynamics, the students learn the mathemati	cal tools to desc	ribe thermodyna
	equilibria.			
	They learn how state variables are	influenced by the mixing of compounds and learn	n concepts to qu	antitatively desc
	these properties.			
	Moreover, the students learn how	phase equilibria can be described mathematically	and which phen	omena may occu
	different phases (vapor, liquid, solid) coexist in equilibrium. Furthermore the fundamen	tals of reaction e	quilibria are taug
	 For different phase equilibria, seven 	eral examples relevant for different kinds of proc	esses are showr	and the necess
	knowledge for plotting and interpret	ing the equilibria are taught.		
Skills	 Applying their knowledge, the stud 	ents are able to identify the correct equation for	the determination	on of the equilibr
	 Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrius state and know how to simplify these equations meaningfully. 			
		an be used to determine the properties of the syst	em in the equilit	orium state and t
	are able to solve the resulting math			
	• For specific applications, they are a	ble to self-reliantly find necessary physico-chemica	I properties of co	ompounds as wel
	model parameters in literature source	ces.		
	Beside pure compound properties the second properties the second properties of the second p	ne students are capable of describing the properties	of mixtures.	
	The students know how to visualize	phase equilibria graphically and they know how to	nterpret the occ	urring phenomen
	 Based on their knowledge, the st 	udents are able to understand fundamental cor	cepts that are	the basis for m
	separation and reaction processes in	n chemical engineering.		
Personal Competence				
Social Competence	The students are able to work in small gro	pups, to solve the corresponding problems and to	present them or	aly to the tutors
	other students			
Autonomy	 The students are able to find necess 	ary information self-reliantly in literature sources a	nd to judge their	quality
		are able to check their learning progress conti		
	knowledge the students can adept t		nuousiy in exert	bused. Bused off
	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and	120 minutes; theoretical questions and cal	culations		
scale				
-		gram, 7 semester): Specialisation Process Engineeri		
Following Curricula		gram, 7 semester): Specialisation Bioprocess Engine	eering: Compulso	vry
	Bioprocess Engineering: Core Qualification			
		ram, 7 semester): Specialisation Bioprocess Engine		ý
	General Engineering Science (English prog Process Engineering: Core Qualification: Co	ram, 7 semester): Specialisation Process Engineerir	ig: Compulsory	

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

Course L0142: Phase 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.

C				
Courses				
Title		Тур	Hrs/wk	СР
Bioprocess Engineering - Fundamentals (L0841) Bioprocess Engineering- Fundamentals (L0842)		Lecture Recitation Section (large)	2	3 1
Bioprocess Engineering - Fundamental Practical Course (L0843)		Practical Course	2	2
			L	L
Module Responsible				
Admission Requirements				
Recommended Previous	none, module "organic chemistry", module	"fundamentals for process engineering"		
Knowledge				
Professional Competence	After taking part successfully, students have	e reached the following learning results		
	enzymes and microorganisms, as well as rheology can be named and mass transp	students should be able to	The parameters of d. The students are	of stoichiometry a
	 predict qualitatively the influence of fermentation process analyze bioprocesses on basis of stoi distinguish between scale-up criteria to compare them as well as to apply propose solutions to complicated biol to explore new knowledge resources identify scientific problems with concerning 	for growth and substrate-uptake and to calcula f energy generation, regeneration of redox ec- chiometry and to set up / solve metabolic flux e for different bioreactors and bioprocesses (and them to current biotechnical problem technological problems and to deduce the corre and to apply the newly gained contents rete industrial use and to formulate solutions. dures as well as results in a scientific manner	quivalents and grow equations aerobic, aerobic as a	wth inhibition on t
	take position to their own opinions and incre	s should be able to debate technical questions ease their capacity for teamwork in engineering s will be able to solve a technical problem in a lenum.	and scientific envi	ronments.
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
workload in Hours				
Credit neinte		Description		
Credit points	Compulsory Bonus Form	Description		
Credit points Course achievement	Yes 5 % Subject theoretica			
Course achievement	Yes 5 % Subject theoretica			
Course achievement Examination	Yes 5 % Subject theoretica practical work			
Course achievement Examination Examination duration and	Yes 5 % Subject theoretica practical work Written exam 90 min		eering: Compulsory	
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr	al and		pry
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification:	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory	gineering: Compulso	-
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng	gineering: Compulso	-
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra General Engineering Science (English progra	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine	gineering: Compulso ineering: Compulso ering: Compulsory	-
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu	gineering: Compulso ineering: Compulso ering: Compulsory Ilsory	-
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory	gineering: Compulso ineering: Compulso ering: Compulsory ulsory	-
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu lants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Com	gineering: Compulso ineering: Compulso ering: Compulsory ulsory impulsory	-
Course achievement Examination Examination duration and scale Assignment for the	Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi	al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu lants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Co agement and Business Administration: Elective	gineering: Compulso ineering: Compulso ering: Compulsory ulsory impulsory	-

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 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	Course 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				
Гitle		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Industr	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	ave reached the following learning results		
Professional Competence				
Knowledge	With completion of this module, the stud	lents can provide an overview of characteristics	of energy systems	s and their econo
	distribution and power trading wih reg	curring in this context. Furthermore, they can exp ard to subject-related contexts. The students of eneral, especially for renewable energy systems al benefits from the use of such systems.	can explain these	aspects, which
Skills	Students are able to apply methodologies for detailed determination of energy demand or energy production for various type energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design t under certain given conditions. Therefore, they can choose the necessary subject-specific 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 o			
Personal Competence	and to put them them into the right conte	AL.		
	The students are able to analyze suitabl	le technical alternatives and to assess them wit	h technical econo	mical and ecolor
		allows them to make an effective contribuition to		
				poner supprj.
Autonomy	Students can independently exploit sour	ces , acquire the particular knowledge about the	e subject area and	I transform it to
	questions.			
	Independent Study Time 96, Study Time in	n Lecture 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 pro	gram, 7 semester): Specialisation Energy and Env	viromental 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 Mechanica	Engineering, Foo	us Energy Syste
	Elective Compulsory		5 5.	5,7 ,
		program, 7 semester): Specialisation Mechanica	l Engineering Foo	us Energy Syste
		sogram, 7 semestery. Specialisation Mechanica	i Engineering, Fut	as Energy Syste
	Compulsory	deligation Chill Frazingeric Station Chill		
		cialisation Civil Engineering: Elective Compulsory		
		cialisation Traffic and Mobility: Elective Compulso	-	
	Civil- and Environmental Engineering: Spe	ecialisation Water and Environment: Elective Comp	oulsory	
	Energy and Environmental Engineering: C	ore Qualification: Compulsory		
	General Engineering Science (English prog	gram, 7 semester): Specialisation Energy and Envi	romental Engineer	ring: Compulsory
	General Engineering Science (English p	rogram, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syste
	Elective Compulsory	gram, 7 semester): Specialisation Process Enginee	ring: Elective Com	pulsory

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 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
Literature	Folien der Vorlesung

Course L0315: Energy System	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 Energy		
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 	

Course L1434: Renewable Energy	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt
Language	DE/EN
Cycle	SoSe
Content	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
Heat and Mass Transfer (L0101)		Lecture	2	2
Heat and Mass Transfer (L0102) Heat and Mass Transfer (L1868)		Recitation Section (small) 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 re	ached the following learning results		
Professional Competence				
Knowledge				
	heat exchanger, chemical reactors).	qualitative and determining quantitative heat racterize different kinds of heat transfer mec		
		ain the physical basis for mass transfer in	detail and to de	scribe mass tran
	qualitative and quantitative by using suitThey are able to depict the analogy betw	veen heat- and mass transfer and to describe	complex linked p	rocesses in detail.
Skills	 The students are able to set reasonable and to balance the corresponding energy 	e system boundaries for a given transport p y and mass flow, respectively.	oblem by using t	he gained knowle
	and to calculate the corresponding heatUsing dimensionless quantities, the studThey are able to distinguish between dif	ents can execute scaling up of technical proc ffusion, convective mass transition and mass	esses or apparatu transfer. They ca	IS.
	 In this context, the students are capable application considering their advantages In addition, they can calculate both, stea The students are capable to connect 	tus (e.g. extraction column, rectification colu to choose and design fundamental types of and disadvantages, respectively. ady-state and non-steady-state processes in p their knowledge obtained in this course find mechanics and chemical process en	heat and mass exp procedural apparat with knowlegde	tus. of other courses
Personal Competence Social Competence	 The students are capable to work on su manner to tutors and other students. 	bject-specific challenges in teams and to pro	esent the results o	orally in a reasona
Autonomy	• They are able to prove their level of k	te necessary information from suitable sourc cnowledge during the course with accompa this basis they can control their learning proc	nying procedure	continuously (clic
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points				
Course achievement				
Examination				
	120 minutes; theoretical questions and calculat	tions		
scale	•			
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Process Engine	ering: Compulsory	
Following Curricula	General Engineering Science (German program			
	General Engineering Science (German program General Engineering Science (German program	n, 7 semester): Specialisation Energy and Env		ering: Compulsory
	Bioprocess Engineering: Core Qualification: Cor			
	Energy and Environmental Engineering: Core Q			
	General Engineering Science (English program,			-
	General Engineering Science (English program,			ring: Compulsory
	General Engineering Science (English program,		ing: compulsory	
	Green Technologies: Energy, Water, Climate: C Technomathematics: Specialisation III. Enginee			

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

Course L1868: Heat and Mas	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	

ourses				
itle		Тур	Hrs/wk	СР
hermal Separation Processes (L01	18)	Lecture	2	2
nermal Separation Processes (L01	19)	Recitation Section (small)	2	2
hermal Separation Processes (L01	41)	Recitation Section (large)	1	1
eparation Processes (L1159)		Practical Course	1	1
	Prof. Irina Smirnova			
•	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamic	s III		
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	 The students can distinguish and destadsorption The students develop an understanding energy demand of a process, the possib They have good knowledge of designing 	g for the course of concentration during a ilities of energy saving, and the selection o	separation process, of separation systems	the estimation of t
Skills	 Using the gained knowledge the studen close the associated energy and materia The students can use different graphic theoretical stages required They can select and design a basic ty disadvantages of the process The students are capable to obtain inde tables) They can calculate continuous and discord The students are able to prove their the The students are able to discuss the the colloquium. 	al balances cal methods for the designing of a separ pe of thermal separation process for a g ependently the needed material properties ontinuous processes oretical knowledge in the experimental lab eoretical background and the content of th	ration process and o iven case based on s from appropriate so work. he experimental work	define the amount the advantages a burces (diagrams a c with the teachers
Personal Competence Social Competence	 technical problems. Other lectures such as the The students can work technical assignment 			utorial
Autonomy	 The students are able to carry out practical lab work in small groups and organize a functional division of labor bet them. They are able to discuss their results and to document them scientifically in a report. The students are capable to obtain the needed information from suitable sources by themselves and assess their qualit The students can proof the state of their knowledge with exam resembling assignments and in this way control learning process 		ssess their quality	
Workload in Hours	Independent Study Time 96, Study Time in Leo	ture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes; theoretical questions and calcula	tions		
-	General Engineering Science (German progran General Engineering Science (German progran General Engineering Science (German progran Compulsory General Engineering Science (German progran Dioprocess Engineering: Core Qualification: Co Energy and Environmental Engineering: Core C General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program	n, 7 semester): Specialisation Bioprocess E n, 7 semester): Specialisation Green Techn ram, 7 semester): Specialisation Green n, 7 semester): Specialisation Energy and E mpulsory Qualification: Elective Compulsory , 7 semester): Specialisation Bioprocess Er , 7 semester): Specialisation Energy and E	ngineering: Compulss ologies, Focus Renew Technologies, Focus Enviromental Enginee ngineering: Compulso nviromental Engineer	ory vable Energy: Elect Renewable Energ ering: Compulsory

Process Engineering: Core Qualification: Compulsory

L

Course L0118: Thermal Sepa	ration Processes
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	
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

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 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

e L1159: Separation Pr	
Тур	Practical Course
Hrs/wk	
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
-	The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquiut takes place in which the students explain and discuss the theoretical background and its translation into practice with staff an fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. The receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they calincrease 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 198: Ullmann"s Enzyklopädie der Technischen Chemie

Module M0892: Chem	ical Reaction Engineering			
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 previous modules mathematics	-III, physical chemistry, technical thermody	namics I+II as w	vell as computationa
Knowledge	methods for engineers.			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of	of chemical reaction engineering. They are a	ble to point out	differences betweer
	thermodynamical and kinetical processes. The s	tudents have a strong ability to outline par	ts of isotherma	I and non-isotherma
	ideal reactors and to describe their properties.			
Skills	After successful completion of the module, studer	nts are able to:		
	- apply different computational methods to dimer	sion isothermal and non-isothermal ideal rea	ctors,	
	- determine and compute stable operation points for these reactors ,			
	- conduct experiments on a lab-scale pilot plants	and document these according to scientific g	uidelines.	
Personal Competence				
-	After successful completition of the lab-course th	e students have a strong ability to organize	themselfes in s	mall groups to solve
,	issues in chemical reaction engineering. The stu			2 .
	their teachers.	-		
Autonomy	The students are able to obtain further infor	mation and assess their relevance auton	omously. Stude	nts can apply thei
	knowldege discretely to plan, prepare and conduc	t experiments.	-	
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes None Subject theoretical ar	nd		
	practical work			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Process Engineeri	ng: Compulsory	
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Bioprocess Engine	ering: Compulso	bry
	Bioprocess Engineering: Core Qualification: Comp	ulsory		
	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7	semester): Specialisation Process Engineerin	g: Compulsory	
	Green Technologies: Energy, Water, Climate: Spe	cialisation Bioresource Technology: Elective	Compulsory	
	Process Engineering: Core Qualification: Compulse	ory		

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

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

	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 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) 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, CST
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

Course L0244: Chemical Read	ction Engineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE
Cycle	WiSe
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 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, rireversible 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 reactor, 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 reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a batch reactor, mole balance of the balance of the plug flow reactor, design of plug flow reactors for reactions with volume change and
Literature	comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical- interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors) non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor) lecture notes Raimund Horn
	skript Frerich Keil Books: M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH G. Emig, E. Klemm, Technische Chemie, Springer A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	 H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998 L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009 J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000 M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010 A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

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

Module M1275: Enviro	onmental Tech	nology			
Courses					
Title			Тур	Hrs/wk	CP
Practical Exercise Environmental Technology (L1387)			Practical Course Lecture	1 2	1 2
Environmental Technologie (L0326	1		Lecture	Z	Z
Module Responsible		litt			
Admission Requirements					
Recommended Previous	Fundamentals of inor	ganic/organic chemistry	and biology		
Knowledge	A.C	<u></u>			
	After taking part succ	cessfully, students have r	reached the following learning results		
Professional Competence					
Knowledge	With the completion of this modul the students obtain profound knowledge of environmental technology. They are able to describ the behaviour of chemicals in the environment. Students can give an overview of scientific disciplines involved. They can expla terms and allocate them to related methods.				
Skills	Students are able to propose appropriate management and mitigation measures for environmental problems. They are able t determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able t work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can preser and defend these opinons in front of and against the group.				
Personal Competence					
Social Competence	The students are able	e to discuss the various t	echnical and scientific tasks, both subject	-specific and multidisci	plinary. They are at
	to develop different a	approaches to the task as	s a group as well as to discuss their theore	etical or practical imple	mentation.
Autonomy	Students can indeper	ndently exploit sources a	bout of the subject, acquire the particular	knowledge and tranfer	it to new problems
Workload in Hours	Independent Study Ti	ime 48, Study Time in Le	cture 42		
Credit points	3				
Course achievement	Compulsory Bonus	Form	Description		
	Yes None	Subject theoretical	and		
		practical work			
Examination	Written exam				
Examination duration and	1 hour				
scale					
Assignment for the	General Engineering	Science (German progra	m, 7 semester): Specialisation Process En	gineering: Elective Com	npulsory
Following Curricula			m, 7 semester): Specialisation Bioprocess		
			m, 7 semester): Specialisation Energy and	l Enviromental Enginee	ring: Compulsory
		ng: Core Qualification: El			
	5,7	5 5	Qualification: Compulsory		
			n, 7 semester): Specialisation Bioprocess		
			n, 7 semester): Specialisation Energy and	-	
			n, 7 semester): Specialisation Process Eng	ineering: Elective Com	puisory
	Process Engineering:	Core Qualification: Elect	ive compulsory		

Course L1387: Practical Exercise Environmental Technology		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Martin Kaltschmitt, Dr. Isabel Höfer	
Language	DE	
Cycle	SoSe	
Content	The practical course Environmental Engineering currently consists of 6 experiments, which deal with the different focal points of environmental engineering in the areas of air, water, soil, environment, biomass and noise. The following experiments are carried out for this purpose: Determination of the calorific value of biomass, soil purification, waste water treatment, noise emissions, plastic waste, biowaste. Translated with www.DeepL.com/Translator (free version) 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		

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, Dr. Isabel Höfer
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
Practical Course Measurement Technology (L2270)			Practical Course	2	2	
Measurement Technology (L2268)			Lecture	2	2	
Physical Fundamentals of Measurement Technology (L2269)			Lecture	2	2	
Module Responsible	Prof. Alexa	Prof. Alexander Penn				
Admission Requirements	None					
Recommended Previous Knowledge		nterest, lo	gical skills, integral-	and differential calculus, basic physical conc	epts such as tempera	ture, mass, velocit
Educational Objectives	After takin	ig part suci	cessfully, students ha	ve reached the following learning results		
Professional Competence						
Knowledge	-			ics (theory of motion), rotation of rigid bo operature and heat, ideal gas.	odies, energy and mo	omentum, electrici
				easurement uncertainty, basics of sensor te vel measurement, flow measurement. Usage o		nciples, temperatu
				calorimetry, image data acquisition, flow mea of solid concentrations, spectroscopy, error ca		
Skills	Literature research, categorisation of thematical topics, analysis of an experimental test stand, preparation of test protocol, fi programming with Matlab, use of relevant laboratory measurement technology, preparation of a test protocol, execution calculations.					
Personal Competence	n.					
Social Competence	experimen	ntal stand		ctical training and learning groups, assessme tion with persons responsible for teaching		-
Autonomy	Time management of the workload, independent development of the thematic basics, personal responsibility for the provision protective equipment and work clothing, practice of presentation in front of a group, active participation in the lecture formulation of enquiries/detailed questions by using clicker.					
Workload in Hours	Independe	ent Study T	ime 96, Study Time i	n Lecture 84		
Credit points	6					
Course achievement	Compulsory No	Bonus 20 %	Form Excercises	Description Popup-Quizzes währen der Vorlesun	g	
	14/	am				
Examination	written ex					
Examination	120 min					
Examination Examination duration and scale	120 min		Science (German pro	aram. 7 semester): Specialisation Process En	aineerina: Compulsory	
Examination Examination duration and	120 min General Er	ngineering		gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Process En		
Examination Examination duration and scale Assignment for the	120 min General Er General Er	ngineering ngineering	Science (German pro		gineering: Compulsory	
Examination Examination duration and scale Assignment for the	120 min General Er General Er General Er	ngineering ngineering ngineering	Science (German pro Science (German pro	gram, 7 semester): Specialisation Process En	gineering: Compulsory Engineering: Compulso	
Examination Examination duration and scale Assignment for the	120 min General Er General Er General Er General Er	ngineering ngineering ngineering ngineering	Science (German pro Science (German pro	gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech	gineering: Compulsory Engineering: Compulso	
Examination Examination duration and scale Assignment for the	120 min General Er General Er General Er Bioprocess	ngineering ngineering ngineering ngineering s Engineeri	Science (German pro Science (German pro Science (German pro ng: Core Qualification	gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech	gineering: Compulsory Engineering: Compulso nologies: Compulsory	
Examination Examination duration and scale Assignment for the	120 min General Er General Er General Er Bioprocess General Er	ngineering ngineering ngineering ngineering s Engineeri ngineering	Science (German pro Science (German pro Science (German pro ng: Core Qualificatior Science (English prog	gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech n: Compulsory	gineering: Compulsory Engineering: Compulso nologies: Compulsory	
Examination Examination duration and scale Assignment for the	120 min General Er General Er General Er Bioprocess General Er Green Tech	ngineering ngineering ngineering ngineering s Engineeri ngineering hnologies:	Science (German pro Science (German pro Science (German pro ng: Core Qualificatior Science (English prog	gram, 7 semester): Specialisation Process En- gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech n: Compulsory gram, 7 semester): Specialisation Process Eng tte: Core Qualification: Compulsory	gineering: Compulsory Engineering: Compulso nologies: Compulsory	

Course L2270: Practical Cour	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		Тур	Hrs/wk	СР
Environmental Assessment (L0860		Lecture	2	2
Environmental Assessment (L1054		Recitation Section (small)	1	1
	Prof. Martin Kaltschmitt			
Admission Requirements				
	Fundamentals of inorganic/organic chemistry and b	iology		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	With the completion of this module the student environmental problems which might occur from p about the methodological diversity and are compet impacts. Besides the students are able to estimate difficulties with their measurement.	roduction processes, projects or construct tent in dealing with different methods and	tion measures.	They have knowled assess environmen
Skills	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 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 environmental impacts.			
Personal Competence				
Social Competence	The students are able to discuss the various technic to develop jointly different solutions and to discu- topics, the students receive insights into the multi- Their sensitivity and consciousness towards these social responsibilities in their role as engineers.	iss their theoretical or practical impleme layered issues of the environment protect	ntation. Due to tion and the con	the selected lectuce cept of sustainabilities
Autonomy	The students learn to research, process and pres scientific work. They can solve an environmental pr			
Workload in Hours	Independent Study Time 48, Study Time in Lecture	42		
Credit points				
Course achievement				
Examination				
Examination duration and scale				
Assignment for the	General Engineering Science (German program, 7 s	emester): Specialisation Process Engineer	ing: Elective Cor	npulsory
-	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s Bioprocess Engineering: Core Qualification: Elective	emester): Specialisation Bioprocess Engin emester): Specialisation Energy and Envir e Compulsory	eering: Elective	Compulsory
	Energy and Environmental Engineering: Core Qualif General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Process Engineering: Core Qualification: Elective Co	emester): Specialisation Bioprocess Engine emester): Specialisation Process Engineeri emester): Specialisation Energy and Enviro	ng: Elective Com	pulsory

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

Course L0860: Environmenta	I Assessment
Тур	Lecture
Hrs/wk	2
CP	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	WiSe/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	WiSe
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

Courses						
Title				Тур	Hrs/wk	СР
Process and Plant Engineering I (LO	095)			Lecture	2	2
Process and Plant Engineering I (L0096)			Recitation Section (large)	1	2	
Process and Plant Engineering I (L1	214)			Recitation Section (small)	1	2
Module Responsible		iki				
Admission Requirements	None					
Recommended Previous	unit operation of thermal an dmechanical separation processes					
Knowledge	chemical reactor eing	gineering				
Educational Objectives	After taking part succ	cessfully, students have	reached the followin	ng learning results		
Professional Competence						
Knowledge	students can:					
	classify and formulat	e blobal balance equatio	ns of chemical proce	esses		
	specify linear compo	nent equations of comple	ex chemical process	es		
		sion and data reconcilliat				
			ion problems			
	explain pfd-diagrams					
Skills	students are capable of					
	- formulation of mass	and energy balance equ	uations and estimati	on of product streams		
	- estimation of compo	onent streams of chemic	al plants using linea	r component balance model	S	
	- solution of data reco	oncilliation tasks				
	- conduction of proce	ss synthesis				
	- economic evaluation	n of processes and the e	stimation of product	tion costs		
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study T	ime 124, Study Time in I	ecture 56			
Credit points						
Course achievement	Compulsory Bonus	Form	Description			
	Yes 10 %	Subject theoretical	and			
		practical work				
Examination	Written exam					
Examination duration and scale	120 Min. lectures not	es and books				
	Concret Engineering		na 7 aona ator). Coa	ciclication Drasses Engineer	ing. Compulson	
				ecialisation Process Engineer ecialisation Bioprocess Engine		
Following curricula	5	ng: Core Qualification: C		cialisation bioprocess Engine	eening. compuise	лу
		-		cialisation Bioprocess Engine	ering: Compulso	24
						-
	Compulsory	Science (English prog	iani, / semester):	Specialisation Energy and	LINITOTHERITAL E	ingineering: Elect
		Science (English program	n 7 comector). Soo	cialisation Process Engineeri	na: Compulson	
				cialisation Process Engineerii		
	Process Engineering:			source Technology: Elective	Compuisory	

Course L0095: Process and P	lant Engineering I	
Тур	Lecture	
Hrs/wk	2	
СР		
Workload in Hours	ndependent 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 Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) Process safety 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

Course L0096: Process and P	ourse L0096: Process and Plant Engineering I	
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Mirko Skiborowski, Dr. Thomas Waluga	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1214: Process and P	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	

C						
Courses						
Title			Тур		Hrs/wk	СР
Particle Technology I (L0434)			Lecture		2	3
Particle Technology I (L0435) Particle Technology I (L0440)			Practical	n Section (small)	1 2	1 2
	Duef Chafe a Universit	- 1-	Flactical	course	Z	Z
Module Responsible		in				
Admission Requirements Recommended Previous						
Knowledge						
Educational Objectives		uccossfully, students	nave reached the following learnir	a roculto		
		iccessiony, students i	lave reached the following learnin	gresuits		
Professional Competence		mplotion of the mode	le students are able to			
Knowledge	Alter successiul co	inpletion of the modu	le students are able to			
	 name and ex 	xplain processes and	unit-operations of solids process	engineering,		
	 characterize 	particles, particle dis	tributions and to discuss their bul	k properties		
Skills	Students are able t	to				
		÷	nd processes for solids processing	-	esired solids prop	erties of the produ
			pehavior in solids processing step	5		
	 document tr 	heir work scientifically				
Personal Competence						
Social Competence	The students are a	able to discuss scier	tific topics orally with other stud	ents or scientific p	ersonal and to d	levelop solutions
	technical-scientific	issues in a group.				
Autonomy	Students are able t	to analyze and solve o	uestions regarding solid particles	independently.		
Workload in Hours		/ Time 110, Study Tim	e in Lecture 70			
Credit points	-	Form	Description			
Credit points Course achievement	Compulsory Bonus	Form Written elaborati	Description on sechs Berichte (pro Ve	rsuch ein Bericht) à	5-10 Seiten	
Course achievement	CompulsoryBonusYesNone	Form Written elaborati	•	rsuch ein Bericht) à	5-10 Seiten	
Course achievement Examination	CompulsoryBonusYesNoneWritten exam		•	rsuch ein Bericht) à	5-10 Seiten	
Course achievement Examination Examination duration and	Compulsory Bonus Yes None Written exam 90 minutes		•	rsuch ein Bericht) à	5-10 Seiten	
Course achievement Examination Examination duration and scale	Compulsory Bonus Yes None Written exam 90 minutes	Written elaborati	on sechs Berichte (pro Ve			
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes General Engineerin	Written elaborati	on sechs Berichte (pro Ve	n Process Engineer	ing: Compulsory	
Course achievement Examination Examination duration and scale	Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin	Written elaborati ng Science (German p ng Science (German p	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio	n Process Engineer n Bioprocess Engin	ing: Compulsory eering: Compulso	
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin General Engineerin General Engineerin	Written elaborati ng Science (German p ng Science (German p ng Science (German p	on sechs Berichte (pro Ve	n Process Engineer n Bioprocess Engin	ing: Compulsory eering: Compulso	
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin General Engineerin Engineerin	Written elaborati ng Science (German p ng Science (German p ng Science (German p ng Science (German p ive Compulsory	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio	n Process Engineer n Bioprocess Engin on Green Technolog	ing: Compulsory eering: Compulso gies, Focus Water	and Environment
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin General Engineerin Engineering: Electif General Engineering: Electif General Engineering	Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio	n Process Engineer n Bioprocess Engin on Green Technolog	ing: Compulsory eering: Compulso gies, Focus Water	and Environment
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin General Engineerin General Engineering: Electitic	Written elaborati ng Science (German p ng Science (German p ng Science (German p ve Compulsory ng Science (German p ering: Core Qualificati	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory	on Process Engineer on Bioprocess Engin on Green Technolog on Energy and Envir	ing: Compulsory eering: Compulso gies, Focus Water	and Environment
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin General Engineering: General Engineering: Electivic General Engineering: Electivic	Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p ering: Core Qualificati nmental Engineering:	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory Core Qualification: Elective Comp	on Process Engineer on Bioprocess Engin on Green Technolog on Energy and Envir ulsory	ing: Compulsory eering: Compulso gies, Focus Water omental Engineer	and Environment
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin Engineering: Electiv General Engineering Electiv	Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p ering: Core Qualificati nmental Engineering: ng Science (English pr	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory Core Qualification: Elective Comp ogram, 7 semester): Specialisatio	on Process Engineer on Bioprocess Engin on Green Technolog on Energy and Envir ulsory n Bioprocess Engine	ing: Compulsory eering: Compulso gies, Focus Water omental Engineer eering: Compulsor	and Environment
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin Engineering: Electivi General Engineering: Electivi General Engineering Electivi General Engineering: Electivi	Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p ering: Core Qualificati nmental Engineering: ng Science (English pr ng Science (English pr	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory Core Qualification: Elective Comp ogram, 7 semester): Specialisatio ogram, 7 semester): Specialisatio	on Process Engineer on Bioprocess Engin- on Green Technolog on Energy and Envir ulsory n Bioprocess Engine n Energy and Enviro	ing: Compulsory eering: Compulso gies, Focus Water omental Engineer eering: Compulsor mental Engineeri	and Environment
Course achievement Examination Examination duration and scale Assignment for the	Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin Engineering: Electiv General Engineering: Electiv General Engineerin Bioprocess Engineer Energy and Enviror General Engineering Energy and Enviror General Engineering Energineerin	Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p ering: Core Qualificati nmental Engineering: ng Science (English pr ng Science (English pr ng Science (English pr	on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory Core Qualification: Elective Comp ogram, 7 semester): Specialisatio	on Process Engineer on Bioprocess Engin- on Green Technolog on Energy and Envir ulsory n Bioprocess Engine n Energy and Enviro n Process Engineerin	ing: Compulsory eering: Compulso gies, Focus Water omental Engineer eering: Compulsor mental Engineeri	and Environment

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 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.	

	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.
	······································
Recommended Previous	
Knowledge Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	 The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods). On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise. The students are able to outline the state of research on a selected issue in their subject area.
Skills	 The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems. With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions. The students can take up a critical position on the findings of their own research work from a specialized perspective.
Personal Competence Social Competence	
	 Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and 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.
Autonomy	 The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame. The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem. The students can apply the essential techniques of scientific work to research of their own.
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0
Credit points	
Course achievement	None
Examination	Thesis
Examination duration and	According to General Regulations
scale	
Assignment for the	
Following Curricula	General Engineering Science (German program, 7 semester): Thesis: Compulsory
	Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory
	Chemical and Bioprocess Engineering: Thesis: Compulsory
	Computer Science: Thesis: Compulsory
	Data Science: Thesis: Compulsory
	Digital Mechanical Engineering: Thesis: Compulsory
	Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory
	Engineering Science: Thesis: Compulsory
	General Engineering Science (English program): Thesis: Compulsory
	General Engineering Science (English program, 7 semester): Thesis: Compulsory
	Green Technologies: Energy, Water, Climate: Thesis: Compulsory
	Computer Science in Engineering: Thesis: Compulsory Integrated Building Technology: Thesis: Compulsory
	Logistics and Mobility: Thesis: Compulsory
	Mechanical Engineering: Thesis: Compulsory
	Mechatronics: Thesis: Compulsory
	Naval Architecture: Thesis: Compulsory
	Technomathematics: Thesis: Compulsory Teilstudiengang Lehramt Elektrotechnik-Informationstechnik: Thesis: Compulsory
	Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory
	Process Engineering: Thesis: Compulsory

Engineering and Management - Major in Logistics and Mobility: Thesis: Compulsory