Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (English program, 7 semester)

Cohort: Winter Term 2019 Updated: 31st May 2021

Table of Contents

Table of Conte		2
Program descr		6
Core qualificat		8
	Chemistry (GES)	8
	Programming in C	10
Module M0736:		12
	Mechanics I (GES) Physics for Engineers (GES)	14 16
	Non-technical Courses for Bachelors	18
	Electrical Engineering I	20
	Technical Thermodynamics I	22
	Electrical Engineering II	24
	Mechanics II (GES)	26
Module M0737:	Mathematical Analysis	28
Module M1348:	Fundamentals of Mechanical Engineering Design (GES)	30
Module M1105:	Engineering Mechanics III (GES)	32
Module M0853:		34
	Technical Thermodynamics II	37
	Advanced Internship AIW/ ES	39
	Civil Engineering	41
	Principles of Building Materials and Building Physics	41
	Structural Analysis I	43
	Structural Analysis II	45
	Building Materials and Building Chemistry	47
the second second second second second second	Reinforced Concrete Structures I	48
Module M0706:		50
	Steel Structures I Introduction to Control Systems	52 54
	Applications in Civil and Environmental Engineering	57
	Computer Engineering	65
Module M0755:		67
	Hydromechanics and Hydrology	69
	Reinforced Concrete Structures II	72
	Structural Design	74
	Water Management	78
Module M0829:	Foundations of Management	80
	Sanitary Engineering I	83
Module M0869:	Hydraulic Engineering	86
Specialization	Bioprocess Engineering	88
Module M0886:	Fundamentals of Process Engineering and Material Engineering	88
	Computer Engineering	90
pa	Biochemistry and Microbiology	92
	Bioprocess Engineering - Fundamentals	96
	Fundamentals of Fluid Mechanics	99
		101
		104
		107
		111 113
	· · · · · · · · · · · · · · · · · · ·	115
		118
		123
	Environmental Technology	125
		127
		129
Module M0829:		132
		135
		135
		137
Module M0610:	Electrical Machines and Actuators	139
		141
		145
Module M0854:		147
		150
		153
		155
		157
		160
		162 164
		167

Module M0777: Semiconductor Circuit Design	169
Module M0734: Electrical Engineering Project Laboratory	171
Module M0829: Foundations of Management	172
Specialization Energy and Enviromental Engineering	175
Module M0933: Fundamentals of Materials Science	175
Module M0598: Mechanical Engineering: Design	178
Module M0730: Computer Engineering	181
Module M0610: Electrical Machines and Actuators Module M0536: Fundamentals of Fluid Mechanics	183 185
Module M0538. Pundamentals of Fluid Mechanics Module M0618: Renewables and Energy Systems	185
Module M0916: Measurement Technology for Mechanical Engineers	190
Module M0655: Computational Fluid Dynamics I	193
Module M1275: Environmental Technology	195
Module M0833: Introduction to Control Systems	197
Module M0546: Thermal Separation Processes	200
Module M0538: Heat and Mass Transfer	205
Module M1274: Environmental Technology	207
Module M0670: Particle Technology and Solids Process Engineering	209
Module M0539: Process and Plant Engineering I	211
Module M0829: Foundations of Management	214
Module M0891: Informatics for Process Engineers	217
Module M1693: Computer Science for Engineers - Programming Concepts, Data Handling & Communication	220
Specialization Computer Science	222
Module M0561: Discrete Algebraic Structures	222
Module M0730: Computer Engineering	223
Module M0624: Automata Theory and Formal Languages	225
Module M0803: Embedded Systems	227
Module M0852: Graph Theory and Optimization	229
Module M0553: Objectoriented Programming, Algorithms and Data Structures Module M0672: Signals and Systems	231 233
Module M0727: Stochastics	235
Module M0721: Functional Programming	230
Module M0834: Computernetworks and Internet Security	240
Module M1578: Seminars Computer Science	242
Module M0833: Introduction to Control Systems	243
Module M0662: Numerical Mathematics I	246
Module M0791: Computer Architecture	248
Module M0562: Computability and Complexity Theory	250
Module M0971: Operating Systems	251
Module M0732: Software Engineering	252
Module M0829: Foundations of Management	254
Module M1269: Lab Cyber-Physical Systems	257
Module M1062: Mathematical Statistics	258 260
Specialization Mechanical Engineering Module M0933: Fundamentals of Materials Science	260
Module M0933: Fundamentals of Materials Science Module M0598: Mechanical Engineering: Design	262
Module M0950: Mechanica Engineering: Design Module M0960: Mechanics IV (Oscillations, Analytical Mechanics, Multibody Systems, Numerical Mechanics)	265
Module M0680, Eluid Dunamics	267
Module M0080. Full Dynamics Module M0956: Measurement Technology for Mechanical Engineers	260
Module M0865: Fundamentals of Production and Quality Management	
Module M0934: Advanced Materials	274
Module M0610: Electrical Machines and Actuators	276
Focus Biomechanics	278
Module M0597: Advanced Mechanical Engineering Design	278
Module M1277: MED I: Introduction to Anatomy	281
Module M1277: MED I: Introduction to Anatomy Module M1278: MED I: Introduction to Radiology and Radiation Therapy	283
Module M0672: Signals and Systems	205
Module M1333: BIO I: Implants and Fracture Healing	288
Module M1279: MED II: Introduction to Biochemistry and Molecular Biology	290
Module M0833: Introduction to Control Systems	
Module M0662: Numerical Mathematics I	200
Module M0730: Computer Engineering	296
Module M1332: BIO I: Experimental Methods in Biomechanics Module M1280: MED II: Introduction to Physiology	
Madula M0020. Foundations of Management	200
	202
FOCUS ENERGY SYSTEMS Module M0730: Computer Engineering	
Module M0730: Computer Engineering Module M0672: Signals and Systems	305
Madda MOCEE. Committed and Ehidd Domensional	
Module M0655: Computational Fluid Dynamics I Module M0597: Advanced Mechanical Engineering Design	310
Module M0833: Introduction to Control Systems	313
Module M0684: Heat Transfer	
Module M1022: Reciprocating Machinery	318
Module M0639: Gas and Steam Power Plants	321
Module M0829: Foundations of Management	324

	207
Module M0618: Renewables Energy Systems	327
Focus Aircraft Systems Engineering	330
Module M0597: Advanced Mechanical Engineering Design	330
Module M0672: Signals and Systems	333
Module M0596: Advanced Mechanical Design Project	336
Module M1320: Simulation and Design of Mechatronic Systems	338
Module M0833: Introduction to Control Systems	340
Module M0655: Computational Fluid Dynamics I	343
Module M0730: Computer Engineering	345
Module M0599: Integrated Product Development and Lightweight Design	347
Module M0767: Aeronautical Systems Module M0829: Foundations of Management	349
	351
Focus Materials in Engineering Sciences	354
Module M0597: Advanced Mechanical Engineering Design	354
Module M0672: Signals and Systems	357
Module M0988: Structural Materials	360
Module M0833: Introduction to Control Systems	362
Module M1009: Material Science Laboratory	365
Module M0662: Numerical Mathematics I	367
Module M0730: Computer Engineering Module M1005: Enhanced Fundamentals of Materials Science	369
	371
Module M0829: Foundations of Management	375
Focus Mechatronics	378
Module M0597: Advanced Mechanical Engineering Design	378
Module M0672: Signals and Systems	381
Module M1320: Simulation and Design of Mechatronic Systems	384
Module M0708: Electrical Engineering III: Circuit Theory and Transients	386
Module M0833: Introduction to Control Systems	388
Module M0730: Computer Engineering	391
Module M0662: Numerical Mathematics I	393
Module M0829: Foundations of Management	395
Module M0777: Semiconductor Circuit Design	398
Module M0854: Mathematics IV	400
Focus Product Development and Production	403
Module M0725: Production Engineering	403
Module M0597: Advanced Mechanical Engineering Design	406
Module M0596: Advanced Mechanical Design Project	409
Module M0833: Introduction to Control Systems	411
Module M0726: Production Technology	414
Module M0730: Computer Engineering	417
Module M0599: Integrated Product Development and Lightweight Design	419
Module M1005: Enhanced Fundamentals of Materials Science	421
Module M0829: Foundations of Management	425
Focus Theoretical Mechanical Engineering	428
Module M0597: Advanced Mechanical Engineering Design	428
Module M0672: Signals and Systems	431
Module M1320: Simulation and Design of Mechatronic Systems	
Module M0725: Production Engineering	436
Module M0596: Advanced Mechanical Design Project	439
Module M0833: Introduction to Control Systems	441
Module M0662: Numerical Mathematics I	444
Module M0730: Computer Engineering	
Module M1573: Modeling, Simulation and Optimization (EN) Module M0829: Foundations of Management	448
Modulo MOQE 4. Mathematics IV	449 452
Specialization Biomedical Engineering	
Module M0933: Fundamentals of Materials Science	455
Module M0730: Computer Engineering Module M0960: Mechanics IV (Oscillations, Analytical Mechanics, Multibody Systems, Numerical Mechanics)	457
	459
Module M0680: Fluid Dynamics Module M0672: Signals and Systems	461 463
Module M1277, MED & Introduction to Anatomy	166
	468
Module M1278: MED I: Introduction to Radiology and Radiation Therapy Module M1279: MED II: Introduction to Biochemistry and Molecular Biology	408
Module M1273: BID I: Implants and Fracture Healing	
	473
Modulo M0694, Host Transfor	476
Madula M0509, Machanical Engineering, Darian	170
Module M0398. Mechanical Engineering. Design Module M0956: Measurement Technology for Mechanical Engineers	481
Madula MOEE2, Numarical Mathematical	484
Module M0662: Numerical Mathematics i Module M0634: Introduction into Medical Technology and Systems	
Module M1332: BIO I: Experimental Methods in Biomechanics	488
Module M0829: Foundations of Management	489
Module M1280: MED II: Introduction to Physiology	492

Specialization Naval Architecture	493
Module M0933: Fundamentals of Materials Science	493
Module M1118: Hydrostatics and Body Plan	495
Module M0730: Computer Engineering	498
Module M0960: Mechanics IV (Oscillations, Analytical Mechanics, Multibody Systems, Numerical Mechanics)	500
Module M0854: Mathematics IV	502
Module M0680: Fluid Dynamics	505
Module M0659: Fundamentals of Ship Structural Design and Analysis	507
Module M0664: Structural Design and Construction of Ships	510
Module M0833: Introduction to Control Systems	512
Module M0655: Computational Fluid Dynamics I	515
Module M0640: Stochastics and Ship Dynamics	517
Module M1109: Resistance and Propulsion	520
Module M1110: Ship Design	521
Module M0829: Foundations of Management	523
Specialization Process Engineering	526
Module M0886: Fundamentals of Process Engineering and Material Engineering	526
Module M0730: Computer Engineering	528
Module M0938: Bioprocess Engineering - Fundamentals	530
Module M0536: Fundamentals of Fluid Mechanics	533
Module M0544: Phase Equilibria Thermodynamics	535
Module M0618: Renewables and Energy Systems	538
Module M0672: Signals and Systems	541
Module M0892: Chemical Reaction Engineering	544
Module M1275: Environmental Technology	548
Module M0833: Introduction to Control Systems	550
Module M1497: Measurement Technology for VT/ BVT	553
Module M0546: Thermal Separation Processes	555
Module M0538: Heat and Mass Transfer	560
Module M1274: Environmental Technology	562
Module M0670: Particle Technology and Solids Process Engineering	564
Module M0539: Process and Plant Engineering I	566
Module M0891: Informatics for Process Engineers	569
Module M1693: Computer Science for Engineers - Programming Concepts, Data Handling & Communication	572
Module M0829: Foundations of Management	574
Thesis	577
Module M-001: Bachelor Thesis	577

Program description

Content

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

Career prospects

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

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

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

Learning target

Knowledge

Students can:

- Name and describe the mathematical and scientific principles and methods of the engineering sciences;
- Ellucidate the principles and methods of the engineering sciences and present an overview of their subject;
- Explain in detail the foundations, methods and areas of application of their specialization, and, as necessary, their particular focus;

• Recite the foundations and methods of the engineering sciences and provide an overview of the relevant social, ethical, ecological and economic marginal conditions of their subject.

Skills

Graduates are able to

- Identify and abstract subject-related problems fundamentally and solve them holistically
- · Identify, combine and apply in an interdisciplinary manner the methods appropriate for the desired analysis, modeling, simulation and optimization
- · Penetrate, analyze and evaluate products and methods from different branches of engineering on a systems technology basis
- Applofdesign methods from different branches of engineering
- Plan and carry out experiments and interpret the results
- Assess the limits of techniques and methods
- Use their knowledge in an interdisciplinary manner and responsible way, taking economic requirements into consideration
- Evaluate problems in a wider societal context and assess the non-technical repercussions of engineering.

Social Competence

Graduates are able to

- Collaborate with both English and German speaking specialists in other disciplines
- · Present the methods and results of their work comprehensively both orally and in writing
- · Communicate with experts and laypersons about the contents and problems of engineering
- · Respond appropriately to inquiries, additions and comments
- · Work in groups, define, allocate and integrate subtasks, reach agreement on schedules and to interact socially.

Autonomy

Graduates are able to

• Familiarize themselves with the relevant literature and effectively use databases and other digital sources of information as well as present the results of their work comprehensively both orally and in writing

- Assess their existing competences realistically and develop and carry out strategies for compensating any deficits they identify
- · Learn a range of subjects and work independently
- · Expand and deepen their understanding through a process of lifelong learning

Program structure

The program is split into the core qualifications, the specialisation qualification and the Bachelor thesis.

The internship and the interdisciplinary final thesis is scheduled for the seventh semester.

Core qualification

Module		corc qu			
	M0701: Chem	istry (GES)			
Courses					
Title			Тур	Hrs/wk	СР
Chemistry (G	GES) I (L0467)		Lecture	2	2
Chemistry (G	GES) I (L0478)		Recitation Section (large)	1	1
	GES) II (L0469)		Lecture	2	2
Chemistry (G	GES) II (L0479)		Recitation Section (large)	1	1
Mo	odule Responsible	Dr. Dorothea Rechtenbach			
Admissi	ion Requirements	None			
Recom	mended Previous	None			
	Knowledge				
Educa	ational Objectives	After taking part successfully, students have re	eached the following learning results		
Professi	ional Competence				
	Knowledge	table, chemical bonds), physical chemistry chemistry (acid/base, pH-value, salts, solubilit	e basic principles and applications of general che (aggregate states, separating processes, th y, redox, metals) and organic chemistry (alipha chanisms, natural products, synthetic polymers	ermodynamics, tic hydrocarbor	kinetics), inorganic s, functional groups,
	Skills		dents are able to describe substance groups and applying specific methods and various reaction m		ounds. On this basis,
Perc	sonal Competence				
	-	Students are able to take part in discussions of	n chemical issues and problems as a member of	an interdiscipli	nary team. They can
	- seia. sompetence	contribute to those discussion by their own sta		2cor urberpfi	
	Autonomy	After successful completion of this module st approaches with arguments. They can also do	udents are able to solve chemical problems ind cument their approaches.	dependently by	defending proposed
v	Norkload in Hours	Independent Study Time 96, Study Time in Leo	cture 84		
	Credit points				
Cor	-	None			
	Examination				
Evamina		120 min			
Examina	scale	120 mm			
۵		General Engineering Science (English program	7 semester): Core qualification: Compulsory		
	ollowing Curricula		,		
	,				
	467: Chemistry (GE	S)			
Course L04	467: Chemistry (GE	S) I			
Course L04 Typ	Lecture	S) I			
Course L04 Typ Hrs/wk	Lecture 2	S) I			
Course L04 Typ Hrs/wk CP	Lecture 2 2				
Course L04 Typ Hrs/wk CP Workload	Lecture 2 2	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours	Lecture 2 2 Independent Study				
Course L04 Typ Hrs/wk CP Workload	Lecture 2 2 Independent Study Dr. Holger Gulyas				
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer	Lecture 2 2 Independent Study Dr. Holger Gulyas				
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer	Lecture 2 2 Independent Study Dr. Holger Gulyas EN				
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table - Electronegativity	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table - Electronegativity - Chemical bonds	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table - Electronegativity - Chemical bonds - Solid compounds a	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table - Electronegativity - Chemical bonds - Solid compounds a - Chemistry of wate	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table - Electronegativity - Chemical bonds - Solid compounds a - Chemistry of wate - Chemical reaction	Time 32, Study Time in Lecture 28			
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matte - Periodic table - Electronegativity - Chemical bonds - Solid compounds a - Chemistry of wate - Chemical reaction - Acid-base reaction - Redox reactions	Time 32, Study Time in Lecture 28	University Press)		
Course L04 Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle Content	Lecture 2 2 Independent Study Dr. Holger Gulyas EN WiSe - Structure of matter - Periodic table - Periodic table - Electronegativity - Chemical bonds - Solid compounds a - Chemical reaction - Acid-base reactions - Gallagher, Ing	Time 32, Study Time in Lecture 28	University Press)		

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

Course L04	69: Chemistry (GES) II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Holger Gulyas
Language	EN
Cycle	WiSe
Content	 Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons, Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction Practical applications and examples
Literature	- Gallagher, Ingram: Complete Chemistry (Oxford University Press) - Corwin: Introductory Chemistry (Pearson) - Burrows, Parsons, Price,Holman: Chemistry3 (Oxford University Press)

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

Courses				
Fitle Programming in C (L0083)		Typ Lecture	Hrs/wk 1	CP 1
Programming in C (L1488)		Practical Course	1	1
Module Responsible	Prof. Siegfried Rump			
Admission Requirements Recommended Previous	None Elementary PC handling skills			
Knowledge	Elementary mathematical skills			
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence	51	5 5		
-	The students know by heart the basic sy purpose.	ntax of C programming as well as its meaning,	intent and	
	They know the fundamental components based on C programming and can explai	s and principles of elementary procedural progr in them:	amming	
	• basic data types (integers, floating point	nt numbers, characters)		
		strings, composed data types, type conversion	ו)	
	operators (arithmetical operations, log			
	control flow (choice, loops, jumps, cond	ditional compilation)		
	functions and macros important standard libraries and function	one		
	 important standard libraries and functi recursion 	ons		
	Iinked lists			
	The students are prepared for continuing	g programming lectures like object oriented pro	ogramming in C++.	
Skills	The students know how to use an integra so that they can write, store, compile an	ated development environment for C programn d execute C programs on it.	ning on a PC	
	Using their knowledge they are able to re	ead and understand given C Programs.		
	They can solve simple algorithmic proble in C language.	ems on their own and can model and program t	heir solutions	
		exercises from other areas of their study like m sics with the aid of small C programs/-projects		
Personal Competence				
Social Competence	The students are able to work in small te programming errors and to present their	eams to solve given weekly tasks, to identify an r results.	id analyze	
	They are able to explain simple phenome			
Autonomy		the given teaching material and solve the giver	ı	
	programming exercises on their own.			
	Additionally, they write small C programs gain a certain programming experience.	s to understand and check addressed issues an	nd also to	
			interd	
	For details beyond the scope of the lectu literature and / or by supplementary owr	are the students inform themselves using the st n research.	Lated	
Workload in Hours Credit points	Independent Study Time 32, Study Time	in Lecture 28		
Course achievement				
	Written elaboration			
Examination duration and				
scale	2 2 County Casks Weekly			
Assignment for the	General Engineering Science (German n	rogram, 7 semester): Core qualification: Compu	ulsory	
-		ogram, 7 semester): Core qualification: Compu	-	

	in C
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE/EN
Cycle	WiSe
Content	C-Programming:
	1. basic data types (integers, floating point numbers, characters, boolean values)
	2. 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)
	 important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h)
	 reporting standard instances and narectoria (search), standard, standard, expering thready standard instances and transcense (search), standard, standard, expering the standard instances and transcense (search), standard, standard, expering the standard instances and transcense (search), standard, standard, expering the standard instances and transcense (search), standard, standard, expering the standard instances and transcense (search), standard, standard, expering the standard instances and transcense (search), standard, standard, expering the standard instances and transcense (search), standard, standard, expering the standard instances and standard instances
	7. example programs for elementation 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	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title		Тур	Hrs/wk	СР	
Linear Algebra (L0642)		Lecture	4	4	
Linear Algebra (L0643)		Recitation Section (large)	2	2	
Linear Algebra (L0645)		Recitation Section (small)	2	2	
Module Responsible	Prof. Marko Lindner				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge	Students can name the basic concepts	in linear algebra. They are able to explain the ns between these concepts. They are capab produce them.			
Skills	 Students can model problems in lineal capable of solving them by applying es Students are able to discover and verify 	r algebra with the help of the concepts stu tablished methods. y further logical connections between the con n develop and execute a suitable approach,	cepts studied in the	e course.	
Personal Competence					
Social Competence	 Students are able to work together (e.g. o different study programs and background kno 				
Autonomy	- Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them.				
	- Students can put their knowledge in relation to the contents of other lectures.				
	- Students have developed sufficient persister	nce to be able to work for longer periods in a g	goal-oriented mann	er on hard probler	
Workload in Hours	Independent Study Time 128, Study Time in L	ecture 112			
Credit points	8				
Course achievement	None				
Examination	Written exam				
Examination duration and	120				
scale					
	Computer Ecience: Core qualification: Comput	000/			
Assignment for the	Computer Science: Core qualification: Computer	SOLA			

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

ourse L0643: Linear Algebra	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Julian Großmann, Jan Meichsner
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0645: Linear Algebr	Course L0645: Linear Algebra	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Julian Großmann	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Mechanics I (GES) (L1373)		Lecture	2	3
Mechanics I (GES) (L1374)		Recitation Section (large)	3	3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	The primary purpose of the study of Statics	is to develop the capacity to predict the effect	cts of forces on rig	jid bodies, structu
	elements and simple structures, which are a	t rest (in equilibrium). Such a capacity is critic	cal to the design o	of many structural
	engineering systems. The particular objective	s of this course are to:		
	1 Introduce the student to the basic pri	nciples required to analyse the effects of for	res applied to rig	id bodies structu
	elements and simple structures in equi		ces applied to lig	
		tructing and solving idealised mathematical m	odels of real engin	eering systems:
		lving skills required to solve a wide variety of r	-	
Skills	At the end of this course the student is able to:			
		ree-dimensional force systems to the analys	is of structural e	lements and sim
	structures in equilibrium.	n ite foren hende alle average en och inken U forenen er sk		
		g its free-body diagram on which all forces acti		
		s acting on a single body or a system of	bodies in two- an	ia three-almensio
	equilibrium using the free-body diagram			
	4. Analyse the internal forces in trusses a			
	 Solve problems of equilibrium with accord Determine mass centres and centroids 			
	6. Determine mass centres and centrolds	or lifes, areas and volumes.		
Personal Competence				
Social Competence	Students can: - work in groups and report on	the findings, - develop joint solutions in mixe	d teams and pres	ent them to other
	assess the team collaboration and their own s	hare in it.		
Autonomy	Students are able to: - solve the problems inc	lependently with the help of hints, - assess the	eir own strengths a	and weaknesses, e
	with the aid of the mid-term test.			
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	1.5 hours Statics: force systems, equilibrium,	mass center, friction, trusses, beams.		
Assignment for the	General Engineering Science (English program	n, 7 semester): Core qualification: Compulsory		
Assignment for the	Scherar Engineering Science (English program	, / semester/. core quaimeation. compuisory		

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

Course 11274 Markenia 1/4				
Course L1374: Mechanics I (0				
Тур	Recitation Section (large)			
Hrs/wk	3			
СР				
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Radoslaw Iwankiewicz			
Language	EN			
Cycle	WiSe			
Content	 Two-dimensional (2D) force systems.: moment of a force about a point, reduction of a system of forces, resultant. Three-dimensional (3D) force systems; moment of a force about a point and about an axis, reduction of a system of forces, resultant, wrench. Supports and bearings, constraints, reactive forces, mechanical system isolation, free-body diagram. Systems with complete and incomplete fixity. Equilibrium in two and three dimensions. Equations of equilibrium. Plane trusses: forces in members, the method of joints and the method of sections. Space trusses. Simple structures: frames and machines. Mass centers and centroids of lines, areas and volumes. Friction: dry friction, types of friction problems. Beams: internal effects- internal forces. Internal forces in curved-in-plane members. * Flexible cables. * Virtual work principle. * Denotes an additional topic. 			
Literature	1. J.L. Meriam and L.G, Kraige, Engineering Mechanics, Vol. 1, Statics, John Wiley & Sons, SI Version, 4 th Edition.			
	2. R.C. Hibbeler, Engineering Mechanics, Statics, Pearson, Prentice Hall, SI, 3 rd Edition.			

Module M1139: Physi	cs for Engineers (GES)			
Courses				
Title Physics for Engineers (GES) (L0557 Physics for Engineers (GES) (L0560		Typ Lecture Recitation Section (small)	Hrs/wk 2 1	CP 3
Module Responsible	Dr. Alexander Petrov			
Admission Requirements	None			
Recommended Previous Knowledge	 Calculus and linear algebra on high schoo Physics on high school level 	l level		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence Knowledge	Students can explain fundamental topics and laws of physics such as in the areas of mechanics, oscillations, waves, and optics.			
Skills	Students can relate physics topics to technical problems. Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise.			
Personal Competence				
Social Competence	Students can jointly solve subject related proble within the framework of the problem solving cou		s effectively	
Autonomy	Students are capable to extract relevant inform the lecture. They can reflect their acquired lev typical exam questions. Students are able to cor	vel of expertise with the help of lecture a	ccompanying mea	
Workload in Hours	Independent Study Time 78, Study Time in Lectu	ıre 42		
Credit points	4			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 Minutes, 10 tasks with parts a) and b)			
Assignment for the Following Curricula	General Engineering Science (English program,	7 semester): Core qualification: Compulsory		

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

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

THE REAL PROPERTY AND A DESCRIPTION OF A	Dagmar Richter
Admission Requirements	
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
rofessional 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 deliberal
	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 seme
	2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a g oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging georiented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. Th
	differences are reflected in the practical examples used, in content topics that refer to different professional application conte
	and in the higher scientific and theoretical level of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leaders functions of Bachelor's and Master's graduates in their future working life.
	Specialized Competence (Knowledge)
	Students can
	 locate selected specialized areas with the relevant non-technical mother discipline,
	outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in
	learning area,different specialist disciplines relate to their own discipline and differentiate it as well as make connections,
	 sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representa
	in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,
	 Can communicate in a foreign language in a manner appropriate to the subject.
Skills	Professional Competence (Skills)
	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 specia
	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.
Personal Competence	
-	Personal Competences (Social Skills)
Social Competence	Personal Competences (Social Skills) Students will be able

	 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.

	ical Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Electrical Engineering I (L0677)		Lecture	3	5
Electrical Engineering I (L0679)		Recitation Section (small)	2	1
Module Responsible	Prof. Manfred Kasper			
Admission Requirements	None			
Recommended Previous Knowledge	None			
	After taking part successfully, students have read	hed the following learning results		
Professional Competence	Alter taking part successionly, students have read			
-	The students know the basic theory, relations a	nd methods of direct current networks and	l of electric and n	nagnetic fields. T
	includes especially:			
	 Kirchhoff's voltage and current laws, Ohm's law, 			
	 methods to simplify and analyze direct cur 	rent networks		
	 description of electric and magnetic fields 			
	Basic material relations,			
	• Gauss's law,			
	Ampère's law,			
	 induction law, 			
	 Maxwell's equation in the integral form, 			
	 concept and definition of resistance, capac 	citance and inductance.		
Skills	The students are able to establish relations betw	een currents and voltages in simple direct of	urrent networks a	and to apply these
	calculate and dimension networks. Student know			
	derive and evaluate relations between field qu	antities. Students know to calculate resist	ance, capacitanc	e and inductance
	simple geometric arrangements.			
Personal Competence				
	Students are able to solve specific problems al	one or in a group and to present the resu	ults accordingly S	tudents can expla
Social competence	concepts and on the basis of examples verify and		into accordingly. S	cuterits curr explu
	······································			
Autonomy	Students are able to acquire particular knowled			
	this knowledge with other fields. The students de	velop perseverance to also solve more com	plicated problems	
Workload in Hours	Independent Study Time 110, Study Time in Lect	ure 70		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	No 10 % Excercises			
Examination				
Examination duration and	120 minutes			
scale				
-	General Engineering Science (English program, 7	semester): Core qualification: Compulsory		
Following Curricula				
Course L0677: Electrical Eng	ineering I			
Тур	Lecture			
Hrs/wk				
CP	5			
Workload in Hours	Independent Study Time 108, Study Time in Lect	ure 42		
	Prof. Manfred Kasper			
Language				
Cycle				
Content				
	1. Basics of Resistive Circuits			
	2. Simplifying Resistive Circuits			
	3. Network Analysis			
	4. The Electrostatic Field			
	 Stationary Currents in Conductive Media Electrostatic Field in Non-Conductive Medi 	a		
	 Electrostatic Field In Non-Conductive Media Static Magnetic Field 	u		

	 Static Magnetic Field Induction and Time-Dependent Fields
Literature	1. M. Kasper, Lecture Notes Electrical Engineering Fundamentals 1, 2013
	2. A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008
	3. P. M. Fishbane: Physics for Scientists and Engineers, Prentice Hall, 1996
	4. M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004
	5. F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005

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

Module M0671: Techn	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)	L)	Recitation Section (small)	1	1
Module Responsible	Prof. Gerhard Schmitz			
Admission Requirements	None			
Recommended Previous	Elementary knowledge in Mathematics and Mecha	anics		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	Students are familiar with the laws of Thermody	namics. They know the relation of the kin	ds of operav acc	ording to 1 st law c
5				
	Thermodynamics and are aware about the limits distinguish between state variables and process		-	-
	enthalpy, entropy and also the meaning of exer	5		
	related diagram. They know the physical differen			
	state. They know the meaning of a fundamental s			
	state. They know the meaning of a fundamental s	tate of equation and know the basies of two	phase mernod	ynannes.
Chille	Chudente ave able to coloulate the internal energy	, the entheling the linetic and the neteration		as work and beat fo
SKIIIS	Students are able to calculate the internal energy simple change of states and to use this calculatio			
	for a real gas from measured thermal state variab			
	Tor a real gas nom measured thermal state variat	JES.		
Developed Commetence				
Personal Competence	The students are able to discuss in small groups a	and develop on oppressed		
Autonomy	The students are able to discuss in small groups a Students are able to define independently tasks,		dae as well as to	find ways to use th
Autonomy	knowledge in practice.	to get new knowledge from existing knowle	uge as well as to	find ways to use the
	knowledge in practice.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 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			
-	Energy and Environmental Engineering: Core qua			
	General Engineering Science (English program, 7	semester): Core qualification: Compulsory		
	Computational Science and Engineering: Specialis	ation Engineering Sciences: Elective Comp	ulsory	
	Mechanical Engineering: Core qualification: Comp	ulsory		
	Mechatronics: Core qualification: Compulsory			
	Orientierungsstudium: Core qualification: Elective	Compulsory		
	Naval Architecture: Core qualification: Compulsor	у		
	Technomathematics: Specialisation III. Engineerin	g Science: Elective Compulsory		
	Process Engineering: Core qualification: Compulse	ory		

	Lecture	
Hrs/wk		
CP		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
	Prof. Gerhard Schmitz	
Language	DE	
Cycle		
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	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerhard Schmitz	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0441: Technical 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	

Courses				
litle		Тур	Hrs/wk	СР
Electrical Engineering II (L0747)		Lecture	3	5
Electrical Engineering II (L0748)		Recitation Section (small)	2	1
Module Responsible	Prof. Manfred Kasper			
	None			
	Content of the Lecture "Electrical Engine	ering I (Elektrotechnik I)"		
Knowledge				
Educational Objectives Professional Competence	After taking part successfully, students r	nave reached the following learning results		
Skills	This includes, in particular: • transients, • the use of complex numbers and • the concept of impedance, • steady state sinusoidal circuit and • complex power and 3-phase syste • transformers, • transfer function and filters, • the concept of resonance, • diodes and rectifiers, • bipolar transistors and operational The students are able to establish relation	ilysis, ems,	ges in linear network	s. The students knc
Personal Competence Social Competence	network analysis. Students are able to solve specific prol concepts and, on the basis of examples	r circuit elements, such as diodes, bipolar trans plems, alone or in a group, and to present the and exercises, verify and deepen their understar	results accordingly. ding.	Students can expla
Autonomy	Students are able to acquire particular knowledge using textbooks in a self-learning process, to integrate, present, and associate this knowledge with other fields. The students develop persistency to also solve more complicated problems.			
Workload in Hours	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points				
Course achievement				
	Written exam			
Examination duration and scale	120 minutes			
	General Engineering Science (English pr	ogram, 7 semester): Core qualification: Compulso	Dry	
Course L0747: Electrical Engi	neering II			
Тур	Lecture			
Hrs/wk	3			
1115/111				
	5			
СР	5 Independent Study Time 108, Study Tim	e in Lecture 42		
CP Workload in Hours		e in Lecture 42		

Cycle	SoSe
Content	 Transients Periodic and sinusoidal signals Power in AC circuits Three-phase systems Transformers Harmonic analysis, transfer functions, filters, locus curve, and Bode plot Resonant circuits Diodes and nonlinear circuits Bipolar transistor and operational amplifier
Literature	 A.R. Hambley: "Electrical Engineering", 5th ed., (Pearson, 2011) M. Albach: "Elektrotechnik", (Pearson, 2011).

Course L0748: Electrical Eng	urse L0748: Electrical Engineering II	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Prof. Manfred Kasper	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1103: Mech	anics II (GES)			
Courses				
Title Mechanics II (GES) (L1417)		Typ Lecture	Hrs/wk	СР 3
Mechanics II (GES) (L1418)		Recitation Section (large)	2	3
Module Responsible	Prof. Radoslaw Iwankiewicz			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The primary purpose of the study of Mechanics of M	aterials/Solids is to develop the capac	ity to predict the	effects of forces of
	elastic bodies, structural elements and simple structure	s, which are at rest (in equilibrium). So	uch a capacity is	critical to the desig
	of many structural or engineering systems. The particul	ar objectives of this course are to:		
	1. Introduce the student to the basic principles rea	quired to analyse the effects of forces	applied to elast	ic bodies. structu
	elements and simple structures in equilibrium;			
	2. Demonstrate sound techniques of constructing a	nd solving idealised mathematical mod	dels of real engin	eering systems;
	3. Promote the analytical and problem-solving skills	required to solve a wide variety of rea	al engineering pro	blems effectively
Skills	At the end of this course the student should be able to:			
	1. Determine average normal and shear stresses.			
	 Determine shear stresses and the angle of twist 	due to torsion of a circular shaft.		
	3. Determine thermal stresses in rods.			
	4. Analyse statically indeterminate rods and shafts.			
	5. Determine area moments of inertia as well as pri	ncipal axes and moments of inertia.		
	6. Determine normal and shear stresses as well as	deflections due to bending.		
	7. Analyse plane state of stress (stress transformati	on).		
	8. Analyse stability of equilibrium of simple systems	and buckling of elastic columns.		
	Determine displacements and solve statically ind	eterminate problems with the aid of e	nergy (Castiglian	o's) method.
Personal Competence				
	Students can: -work in groups and report on the findin	gs, - develop joint solutions in mixed	teams and prese	ent them to others
•	assess the team collaboration and their own share in it.	- • •		
Autonomy	Students are able to; - solve the problems independent	ly with the help of hints, - assess their	own strengths a	ind weaknesses, e
	with the help of the mid-term test.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	1.5 hours Mechanics of Solids: stress and strain due to	axial loading, torsion, bending, stress	transformation,	moments of inert
scale	buckling, energy methods.			
Assignment for the	General Engineering Science (English program, 7 seme	ster): Core qualification: Compulsory		
Following Curricula				

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

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

Courses				
Title		Тур	Hrs/wk	СР
Mathematical Analysis (L0647)		Lecture	4	4
Mathematical Analysis (L0648)		Recitation Section (large)	2	2
Mathematical Analysis (L0649)		Recitation Section (small)	2	2
Module Responsible	Prof. Marko Lindner			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	 Students can name the basic concepts in analysis. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections w the help of examples. They know proof strategies and can reproduce them. 			
Skills	 Students can model problems in analysis with the help of the concepts studied in this course. Moreover, they are capable 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		g. on their regular home work) in heterogened knowledge) and to present their results approp		
Autonomy	ηy - Students are capable of checking their understanding of complex concepts on their own. They can specify op precisely and know where to get help in solving them.			ecify open questio
	- Students can put their knowledge in relat	ion to the contents of other lectures.		
	- Students have developed sufficient persi	stence to be able to work for longer periods in a	goal-oriented manr	ner on hard probler
Workload in Hours	Independent Study Time 128, Study Time	in Lecture 112		
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Computer Science: Core qualification: Com	npulsory		

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

Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Julian Großmann, Jan Meichsner
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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

Courses					
Title		Тур	Hrs/wk	СР	
Fundamentals of Mechanical Engir		Lecture	2	3	
Fundamentals of Mechanical Engir		Recitation Section (sma	all) 2	3	
Module Responsible	Dr. Arthur Seibel				
Admission Requirements					
Recommended Previous	 Basic knowledge about mechanic 	s and production engineering			
Knowledge	Internship (Stage I Practical)				
	After taking part successfully, students l	have reached the following learning results			
Professional Competence	After passing the module, students are	able to:			
Knowledge	After passing the module, students are a	able to.			
	explain basic working principles a				
		criteria, application scenarios and practical exa	amples of basic machi	ne elements, indica	
	the background of dimensioning of	calculations.			
Skills	After passing the module, students are a	able to:			
	 accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), 				
	 recognize the content of technical drawings and schematic sketches, 				
	technically evaluate basic designs	S.			
Personal Competence					
		formation in the lecture supported by activatir	ıg methods.		
Autonomy	Students are able to independent	ly deepen their acquired knowledge in exercise	es.		
	 Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by us 			g. by using the vid	
	recordings of the lectures.				
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56			
Credit points	6				
Course achievement					
	Written exam				
Examination duration and	120 min				
scale					
Assignment for the Following Curricula	General Engineering Science (English pr	ogram, 7 semester): Core qualification: Compu	Isory		
Following Curricula					
Course L1898: Fundamental	s of Mechanical Engineering (GES)				
	Lecture				
Hrs/wk					
СР					
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28			
Lecturer	Dr. Arthur Seibel				
	t				
Language	EN				

	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	
Literature	

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

Courses					
Title		Тур	Hrs/wk	СР	
Mechanics III (GES) (L1421)		Lecture	3	3	
Mechanics III (GES) (L1420)		Recitation Section (small)	2	2	
Mechanics III (GES) (L1419)		Recitation Section (large)	1	1	
Module Responsible	Prof. Robert Seifried				
Admission Requirements	None				
Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have reached th	e following learning results			
Professional Competence					
Knowledge	The primary purpose of the study of Mechanics III (Flui				
	effects of forces and motions, necessary for the anal			nachinery, vehic	
	aircraft, spacecraft, automatic control systems, etc.The	particular objectives of this course are	e to:		
	1. Determine the hydrostatic forces acting on differ	ent objects.			
	2. Analyse stability of floating bodies.				
	3. Analyse the kinematics and kinetics of a particle	in different reference systems,			
	4. Analyse the motion of the system of particles an	d forces acting on it,			
	5. Analyse the plane motion of a rigid body (simple	mechanism) and forces acting on it.			
	6. Analyse the three-dimensional motion of a rigid k	ody and forces acting on it.			
Skills	At the end of this course the student should be able to:				
	 Solve the equilibrium problems with account for hydrostatic pressure forces. Analyze at hills of simple floating hading 				
	2. Analyse stability of simple floating bodies.				
	3. Calculate the velocity and acceleration of a particle in different reference systems.				
	• 4. Derive and solve the equation of motion of a p	article in different reference systems.			
	5. Analyse the motion of the system of particles and forces acting on it with the aid of work-energy and impulse-relationships,6. Calculate the instantaneous linear and angular velocities and accelerations of the planar mechanisms.				
	 Consider the instantaneous infeat and angular velocities and accelerations of the planar mechanisms. Derive and solve the equations of a plane motion of a rigid body and find forces acting on it, 				
	8. Apply work-energy and impulse-momentum relations	nips to analyse plane kinetics of a rigi	d body.		
	9. Calculate the instantaneous linear and angular veloc	ities and accelerations of the three-d	imensional motio	n of a rigid body.	
	10. Derive the equations of a motion of a three-dimens	onal motion of a rigid body.			
	11. Apply in three-dimensional kinematics and kinetics	of rigid body both methods of vector	algebra and mati	ix methods.	
Personal Competence					
Social Competence	Students can: - work in groups and report on the findir assess the team collaboration and their share in it.	gs, - develop joint solutions in mixed	teams and prese	ent them to othe	
Autonomy	Students are able to: -solve the problems independent	v with the help of hints assess their	r own strengths a	nd weaknesses	
hatehenny	with the aid of the mid-term test.		onn sa angais a		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	2 hours Fluid Statics: hydrostatic pressure, buoyancy,	stability of floating vessels. Kinemat	tics of particle, or	plane and 3D r	
scale	bod,y. Kinetics of particle, system of particles, of plane	and 3D rigid body. Vector and matrix	algebra formulati	on.	
Assignment for the	Engineering Science: Core qualification: Compulsory				
Following Curricula	General Engineering Science (English program, 7 seme	ter): Core qualification: Compulsory			
	Computational Science and Engineering: Specialisation	Engineering Sciences: Elective Compu	llsory		
Course L1421: Mechanics III	(GES)				
Тур	Lecture				

Course L1421: Mechanics III	(025)
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Radoslaw Iwankiewicz
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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

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

Module M0853: Math	ematics III			
Courses				
Title		Тур	Hrs/wk	CP
Analysis III (L1028)		Lecture	2	2
Analysis III (L1029)		Recitation Section (small)	1	1
Analysis III (L1030)		Recitation Section (large)	1	1
Differential Equations 1 (Ordinary E	-	Lecture Recitation Section (small)	2 1	2
Differential Equations 1 (Ordinary E			1	1
Differential Equations 1 (Ordinary E		Recitation Section (large)	T	T
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics I + II			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence		5 5		
Knowledge				
Knowledge	 Students can name the basic concepts in the 	area of analysis and differential equation	s. They are able	to explain them usi
	appropriate examples.			
	 Students can discuss logical connections bet 	ween these concepts. They are capable	of illustrating th	ese connections wi
	the help of examples.			
	 They know proof strategies and can reproduce 	e them		
Skills	Students can model problems in the area of	analysis and differential equations with th	he help of the co	ncents studied in th
	-			neepts studied in ti
	course. Moreover, they are capable of solving			
	Students are able to discover and verify furth			
	 For a given problem, the students can develop 	elop and execute a suitable approach, a	nd are able to c	ritically evaluate t
	results.			
Personal Competence				
Social Competence				
Social competence	 Students are able to work together in teams. They are capable to use mathematics as a common language. 			age.
	 In doing so, they can communicate new cond 	cepts according to the needs of their coop	perating partners	. Moreover, they c
	design examples to check and deepen the ur	nderstanding of their peers.		
Autonomy				
Autonomy	 Students are capable of checking their under 	rstanding of complex concepts on their o	wn. They can sp	ecify open questio
	precisely and know where to get help in solvi			
	 Students have developed sufficient persiste 		ls in a goal-orien	ted manner on ha
	problems.	hee to be able to work for longer period	is in a goar orien	
	problems.			
Workload in Hours	Independent Study Time 128, Study Time in Lecture	e 112		
Credit points	8			
Course achievement	None			
Examination	Written exam			
		5 1)		
	60 min (Analysis III) + 60 min (Differential Equation	5 1)		
scale				
-	General Engineering Science (German program, 7 s			
Following Curricula	Civil- and Environmental Engineering: Core qualification	ation: Compulsory		
	Bioprocess Engineering: Core qualification: Compute	sory		
	Computer Science: Core qualification: Compulsory			
	Data Science: Core qualification: Compulsory			
	Digital Mechanical Engineering: Core qualification: (Compulsory		
	Electrical Engineering: Core qualification: Compulso			
	Energy and Environmental Engineering: Core qualifi	•		
	Engineering Science: Core qualification: Compulsory			
	General Engineering Science (English program, 7 se			
	Computational Science and Engineering: Core quali			
	Mechanical Engineering: Core qualification: Compul	sory		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Process Engineering: Core qualification: Compulsory	/		

Course L1028: Analysis III		
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 differential and integrational calculus of several variables	
Literature	 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
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 L1031: Differential Equations 1 (Ordinary Differential Equations)		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	WiSe	
Content	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 	

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

Literature

See interlocking course

Courses				
		T	there is a large	67
Title		Typ Lecture	Hrs/wk 2	CP 4
Technical Thermodynamics II (L044 Technical Thermodynamics II (L045		Recitation Section (large)	1	4
Technical Thermodynamics II (L045		Recitation Section (mage)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous		anics and Tochnical Thormodynamics I		
Knowledge				
-	After taking part successfully, students have	reached the following learning results		
Professional Competence	After taking part successionly, students have	reached the following learning results		
	clockwise and clockwise cycles (heat-power of draw the different cycles in Thermodynami processes and are able to perform simple co- know the definition of the speed of sound and Students are able to use thermodynamic law exergy- and entropy balances and by this to	and know the influence different factors. Ti cycle, cooling cycle). They have increased kno cs related diagrams. They know the laws of mbustion calculations. They are provided with d know about a Laval nozzle.	ney know the diffe wledge of steam c gas mixtures, esp n basic knowledge ially they are able to perform simple s	erence between a ycles and are able becially of humid in gas dynamics a to formulate ener safety calculations
Personal Competence	The students are able to discuss in small gray	ups and doubles as approach		
Social Competence	The students are able to discuss in small grou	aps and develop an approach.		
Autonomy	Students are able to define independently tak	sks, to get new knowledge from existing know	ledge as well as to	find ways to use t
Workload in Hours	Independent Study Time 124, Study Time in I	ecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and	90 11/11			
scale				
Assignment for the	5 5 . 1 5	m, 7 semester): Core qualification: Compulsor	ý	
Following Curricula	Bioprocess Engineering: Core qualification: Co			
	Energy and Environmental Engineering: Core			
	Energy Systems: Technical Complementary C			
	Engineering Science: Core qualification: Com			
	Engineering Science: Specialisation Mechanic	5 5 1 5		
		n, 7 semester): Core qualification: Compulsory		
		n, 7 semester): Specialisation Mechanical Engi	-	ompulsory
		cialisation Engineering Sciences: Elective Com	pulsory	
	Mechanical Engineering: Core qualification: C			
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engine			
	Process Engineering: Core qualification: Com	pulsory		

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

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

Course L0451: Technical 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	

Courses				
Title		Тур	Hrs/wk	СР
	ship-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 Scie	nce		
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students of the different specialisations get experiences in typical scope of duties of engineers, who are working in a development			
	division, planning division or in the management of a company. In the framework of this environment the know		the knowledge fro	
	university can used a first time for real engin	neering tasks.		
Chille	Chudonte of the different encoiclinations at	uld be interreted in turical day's world	. Du this they are learn	ing hunical tools, a
SKIIIS	Students of the different specialisations sho functions of engineers. They are able to struc			
	functions of engineers. They are able to struct	ture and organize their working day and		in time.
Personal Competence				
Social Competence	Students are able to cooperate with co-worke	ers in a company and to understand the	language of engineers.	
Autonomy	Students can finish own tasks.			
Workload in Hours	Independent Study Time 512, Study Time in	Lecture 28		
Credit points	18			
Course achievement	None			
Examination	Written elaboration (accord. to Internship Re	gulations)		
Examination duration and	see Internship Regulations			
scale				
Assignment for the	General Engineering Science (German progra	m, 7 semester): Core qualification: Com	pulsory	
Following Curricula	Engineering Science: Core qualification: Com	pulsory		
	General Engineering Science (English program			

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 intensive exchange with fellow students, the students also gain insights into the internships of their peers. This gives them an impression of their professional opportunities far beyond their own internship. The concrete application example of the advanced internship thus promotes the acquisition and consolidation of competences in career management skills that can be transferred to later career steps.	
Literature		

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

Specialization Civil Engineering

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

Module M0580: Princi	ples of Building Materials ar	nd Building Physics		
Courses				
Title		Тур	Hrs/wk	СР
Building Physics (L0217)		Lecture	2	2
Building Physics (L0219)		Recitation Section (large)	1	1
Building Physics (L0247)		Recitation Section (small)	1	1
Principles of Building Materials (L02	215)	Lecture	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Knowledge of physics, chemistry and mat	hematics from school		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students are able to identify fundame	ental effects of action to materials and structures,	to explain different	t types of mechanica
	behaviour, to describe the structure of	building materials and the correlations betwe	en structure and	other properties, t
		n processes and to describe the most important		
		rement in the field of protection against moisture	-	
Skills	The students are able to work with the most important standardized methods and regularities in the field of moisture protection			
	the German regulation for energy saving,	fire protection and noise protection in the case of	f a small building.	
Personal Competence				
	The students are able to support each oth	ner to learn the very extensive specialist knowledge	ae.	
Autonomy	The students are able to make the timing	and the operation steps to learn the specialist kn	owledge of a very e	extensive field.
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	2 h written exam			
scale				
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Civil Engineeri	ng: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Cor	re qualification: Compulsory		
	General Engineering Science (English pro	gram, 7 semester): Specialisation Civil Engineerin	g: Compulsory	
	Orientierungsstudium: Core qualification:	Elective Compulsory		
	Technomathematics: Specialisation III. En	gineering Science: Elective Compulsory		

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

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

Course L0247: Building Phys	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	Course L0215: Principles of Building Materials	
	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	-	ompleting this module, stu	dents can express the basic aspects of linea	ir frame analysis of	statically determina
	systems.				
Skills	After successful cor	mpletion of this module, th	e students are able to distinguish between	statically determina	ate and indetermina
	structures. They are	e able to analyze state va	riables and to construct influence lines of	statically determin	ate plane and spat
	frame and truss stru	uctures.			
Personal Competence					
Social Competence	Students can				
	 participate in 	subject-specific and interc	isciplinary discussions,		
	defend their	own work results in front of	others		
		scientific development of c	-		
	 Furthermore, 	they can give and accept	professional constructive criticism		
Autonomy	The students are al	ble work in-term homewor	k assignments. Due to the in-term feedba	ck, they are enable	d to self-assess th
	learning progress du	uring the lecture period, all	ready.		
Weedle ed by Using	In dama and and Church .	Time 124 Church Time in L	struct 50		
Workload in Hours Credit points	6	Time 124, Study Time in Le	ecture 56		
Course achievement	o Compulsory Bonus	Form	Description		
Course achievement	No 10 %	Written elaboration	Hausübungen mit Testat, betreut durc	h Studentische Tuto	ren (Tutorium)
Examination	Written exam				
Examination duration and	90 Minuten				
scale					
Assignment for the	General Engineering	g Science (German progran	n, 7 semester): Specialisation Civil Engineer	ing: Compulsory	
Following Curricula	General Engineering	g Science (German progran	n, 7 semester): Specialisation Civil Engineer	ing: Compulsory	
		ental Engineering: Core qu			
		ental Engineering: Core qu			
			, 7 semester): Specialisation Civil Engineeri	ng: Compulsory	
			ering Science: Elective Compulsory		
	reconomatnematics	s. specialisation III. Enginee	ering Science: Elective Compulsory		
Course L0666: Structural An	alvsis I				
	Lecture				
Hrs/wk	2				
CP CP	2				

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	rse 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			

Module M0744: Struc	tural Analysis II				
Courses					
Title		Тур		Hrs/wk	СР
Structural Analysis II (L0673)		Lectu	re	2	3
Structural Analysis II (L0674)			ation Section (large)	2	3
Module Responsible	Prof. Uwe Starossek				
Admission Requirements	None				
Recommended Previous	- Markanian I/II				
Knowledge	Mechanics I/II Mathematics I/II				
	Differential Equations I				
	Structural Analysis I				
Educational Objectives	After taking part successfully, students ha	ave reached the following lea	rning results		
Professional Competence					
Knowledge	After successful completion of this mo	dule, students can express	the basic aspects o	f linear frame ar	nalysis of statically
	indeterminate systems.				
CI-III-			analisa atata wasialila		-t influence lines of
Skills	After successful completion of this modu statically inderminate plane and spatial fr		analyze state variable	s and to construc	ct influence lines of
	statically indeminate plane and spatial in	anie and truss structures.			
Personal Competence					
Social Competence	Students can				
	 participate in subject-specific and i 	nterdisciplinary discussions,			
	defend their own work results in fro				
	promote the scientific developmen				
	 Furthermore, they can give and acceleration 	cept professional constructive	e criticism		
Autonomy	The students are able to work in-term ho	mework assignments. Due to	the in-term feedback,	they are enabled	to self-assess their
	learning progress during the lecture period	d, already.			
Workload in Hours		in Lecture 56			
Credit points		Description			
Course achievement	Compulsory Bonus Form No 10 % Written elaboratio	•	Festat, betreut durch St	udentische Tutore	en (Tutorium)
Examination		······································			
Examination duration and					
scale					
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialis	ation Civil Engineering:	Compulsory	
Following Curricula	Civil- and Environmental Engineering: Cor	e qualification: Compulsory			
	General Engineering Science (English pro	gram, 7 semester): Specialisa	ation Civil Engineering:	Compulsory	
Course L0673: Structural An					
Тур					
Hrs/wk	2				
CP	3	- L			
Workload in Hours		n Lecture 28			
Lecturer					
Language					
Cycle	505e				
Content	 Linear structural analysis: statically 	/ indeterminate systems			

	- Encer structure analysis, staticarly 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	rse 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			

Courses						
Title			Тур		Hrs/wk	СР
Building Materials and Building Ch	emistry (L0248)		Lecture		4	4
Building Materials and Building Ch	emistry (L0249)		Recitation Se	ection (small)	1	2
Module Responsible	Prof. Frank Schmidt-	Döhl				
Admission Requirements	None					
Recommended Previous	Module Principles of	Building Materials and	Building Physics			
Knowledge						
Educational Objectives	After taking part suc	cessfully, students hav	e reached the following learning r	esults		
Professional Competence						
Knowledge	The students are	able to explain the r	nost important components, the	e manufacture,	the structure, t	the most importa
	characteristics of th	e mechanical behaviou	Ir and the corrosion behaviour, t	he material testi	ing and the field	s of utilization of
	relevant building ma	aterials.				
Skille	The students are a	hip to access the usat	pility of building materials for di	fferent application	ons and to selec	t building materi
Skills			disadvantages. The students are a			
	- · ·	-	-			
			the actual rules and the connecti		e characteristic c	oncrete paramete
	They are able to sele	ect suitable materials a	nd mixtures to avoid damage proc	esses.		
Personal Competence						
Social Competence	The students are able to support each other to learn the very extensive specialist knowledge in learning groups and to carry o					
	exercises in small groups in the lab.					
Autonom	The students are sh	la ta malia tha timina a	ad the exerction store to leave the		ladra of a yor (a	utoncius field
Autonomy	The students are ab	ie to make the timing a	nd the operation steps to learn the	e specialist know	ledge of a very e	extensive neid.
Workload in Hours	Independent Study	Time 110, Study Time ir	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 (German prog	ram, 7 semester): Specialisation C	Civil Engineering:	Compulsory	
Following Curricula	5 5		qualification: Compulsory	5 5		
			am, 7 semester): Specialisation Ci	vil Engineering:	Compulsory	
		,,,,, progr	,, opecialisation of			

Course L0248: Building Mate	erials 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 Mate	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, André Rössler		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

ourses						
ïtle			Тур		Hrs/wk	СР
Project Seminar Concrete I (L0896)			Seminar		1	1
Reinforced Concrete Design I (L030	3)		Lecture		2	3
Reinforced Concrete Design I (L030	5)		Recitation	Section (large)	2	2
Module Responsible	Prof. Günter Rombac	h				
Admission Requirements	None					
Recommended Previous	Basic knowledge in s	tructural analysis and	d building materials.			
Knowledge	Modules: Structural	Analysis I, Mechanics	1+11			
Educational Objectives	After taking part succ	cessfully, students ha	ave reached the following learnin	g results		
Professional Competence						
Knowledge	The students can out	tline the history of co	ncrete construction and explain	the basics of struct	ural engineering,	including usual le
	combinations and sa	fety concepts. They	are able to draft and dimension	simple structures, a	as well as to eval	uate and discuss
	behaviour of the mat	terials and of structur	al members.			
Skills	The students are abl	le to apply basic prod	edures of the conception and di	mensioning to prac	tical cases. They	are capable to d
simple concrete structures and to design them for bending and bending with axial force, and to plan th						
			and construction sketches and			5
	,	,,				
Personal Competence						
Social Competence						
,	The students are abl	o to corru out cimplo	tasks in the conception and dime	ancioning of structu	roc and to critica	lly reflect the recu
Autonomy	The students are able	e to carry out simple	tasks in the conception and dime			ily reliect the rest
Workload in Hours	Independent Study T	ime 110, Study Time	in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Excercises				
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	General Engineering	Science (German pro	ogram, 7 semester): Specialisatio	n Civil Engineering:	Compulsory	
Following Curricula						

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

Course L0303: Reinforced Cor	ncrete Design I
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	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 Co	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 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)		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 hav	ve reached the following learning results		
Professional Competence				
Knowledge	The students know the basics of soil mech	anics as the structure and characteristics of soil,	stress distribution	due to weight, wa
-	or structures, consolidation and settlement	t calculations, as well as failure of the soil due to g	ground- or slope fa	ilure.
Skills	After the successful completion of the mod	dule the students should be able to describe the	mechanical prope	rties and to evalua
	them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight o			
	influence of structures. They are are able to	o prove the usability (settlements) for shallow fou	indations.	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement		Description		
	No 20 % Attestation			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Civil Engineering	g: Compulsory	
Following Curricula	General Engineering Science (German prog	gram, 7 semester): Specialisation Civil Engineering	g: Compulsory	
	Civil- and Environmental Engineering: Core	e qualification: Compulsory		
	Civil- and Environmental Engineering: Core	e qualification: Compulsory		
	General Engineering Science (English progr	ram, 7 semester): Specialisation Civil Engineering	: Compulsory	
	Technomathematics: Specialisation III. Eng	ineering Science: Elective Compulsory		
	Technomathematics: Specialisation III. Eng	ineering 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

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

Course L1493: Soil Mechanics	S
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

Module M0611: Steel	Structures I			
Courses				
Title		Тур	Hrs/wk	СР
Steel Structures I (L0299)		Lecture	2	3
Steel Structures I (L0300)		Recitation Section (large)	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	 Chryshurst analysis I. Chryshurst analysis II. 			
Knowledge	Structural analysis I, Structural analysis II Machanica I, Machanica II			
	 Mechanics I, Mechanics II Building Materials and Building Chemistry 			
	 Principles of Building Materials and Building 	Physics		
		J FILYSICS		
Educational Objectives	After taking part successfully, students have reac	hed 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 men 	ners in tension, compression and bending		
Skills	<i>Ills</i> Students can rate and apply the material steel appropriately with respect to its properties and usage.			
	They can use the security concept with respect to	loads, forces and resistances.		
	They can check the ultimate limit state and the se	erviceability of simple members in tensior	, compression and	bending.
Personal Competence				
Social Competence	After participation of an optional course (building	of a simple truss) they are able to orga	nize themselves in	groups. They will b
	successful in guided building a truss with bolted o	onnections according to design drawings.		
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Civil Engineeri	ng: Compulsory	
Following Curricula				
	General Engineering Science (English program, 7	semester): Specialisation Civil Engineerin	g: Compulsory	
Course L0299: Steel Structu	res I			
Тур	Lecture			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lectur	e 28		

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

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/w	k (СР
ntroduction to Control Systems (L		2		4
ntroduction to Control Systems (L	0655) Recitation Section (small	all) 2	:	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
	Representation of signals and systems in time and frequency domain, Laplace transfor	rm		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time and frequency domai 	n, and can in parti	icular expla	ain properties
	first and second order systems			
	 They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency respon root locus 			cy response ai
	 They can explain the Nyquist stability criterion and the stability margins derived 	from it		
	 They can explain the role of the phase margin in analysis and synthesis of contr 			
	• They can explain the way a PID controller affects a control loop in terms of its fr	equency response		
	They can explain issues arising when controllers designed in continuous time do	omain are impleme	ented digita	ally
Skills				
	Students can transform models of linear dynamic systems from time to frequen	cy domain and vice	e versa	
	 They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tunin 	a ruloc		
	 They can analyze and synthesize simple control loops with the help of root locus 	5	sponse teo	hniques
	They can calculate discrete-time approximations of controllers designed			
	implementation			
	They can use standard software tools (Matlab Control Toolbox, Simulink) for car	rying out these tas	sks	
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problems, and experiment	ally validate their	controller o	designs
Autonomy	Students can obtain information from provided sources (lecture notes, software do	cumentation, expe	riment gu	ides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-line tests and thereby control their learn	nina proaress.		
		51 5		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Workload in Hours Credit points				
	6			
Credit points Course achievement	6			
Credit points Course achievement	6 None Written exam			
Credit points Course achievement Examination	6 None Written exam 120 min			
Credit points Course achievement Examination Examination duration and	6 None Written exam 120 min	ulsory		
Credit points Course achievement Examination Examination duration and scale	6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Comp	ulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the		ulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 6 Vone Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Comp Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Data Science: Core qualification: Elective Compulsory	ulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the		ulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the		·	ulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the		ngineering: Compt		
Credit points Course achievement Examination Examination duration and scale Assignment for the		ngineering: Comp eering: Compulsor	y	
Credit points Course achievement Examination Examination duration and scale Assignment for the		ngineering: Comp eering: Compulsor Engineering: Com	y pulsory	Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the		ngineering: Comp eering: Compulsory Engineering: Com I Enviromental Eng Science: Compulso	y pulsory gineering: (pry	
Credit points Course achievement Examination Examination duration and scale Assignment for the		ngineering: Comp eering: Compulsory Engineering: Com I Enviromental Eng Science: Compulso	y pulsory gineering: (pry	
Credit points Course achievement Examination Examination duration and scale Assignment for the		ingineering: Compu eering: Compulson Engineering: Com Enviromental Eng Science: Compulso chanical Engineeri	y pulsory gineering: (ory ing, Focus	Biomechanic
Credit points Course achievement Examination Examination duration and scale Assignment for the		ingineering: Compu eering: Compulson Engineering: Com Enviromental Eng Science: Compulso chanical Engineeri	y pulsory gineering: (ory ing, Focus	Biomechanic
Credit points Course achievement Examination Examination duration and scale Assignment for the		ingineering: Compusering: Compusering: Compulsory Engineering: Com I Enviromental Eng Science: Compulso chanical Engineering anical Engineering	y pulsory gineering: (ing, Focus I, Focus E	Biomechanic
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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 to Control Systems			
Тур	Lecture		
Hrs/wk	2		
CP	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	Signals and systems		
	 Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control 		
	Reference tracking and disturbance rejection		
	Types of feedback, PID control		
	System type and steady-state error, error constants		
	Internal model principle		
	Root locus techniques		
	Root locus plots		
	Root locus design of PID controllers		
	Frequency response techniques		
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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 equationsTustin 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	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses			
litle .	Тур	Hrs/wk	СР
Applied Structural Dynamics (L079)		2	2
Soil Laboratory Course (L0499)	Practical Course	1	2
Building Information Modeling (L19	03) Lecture	1	1
Building Information Modeling (L19		2	2
Computational Analysis of Structure		2	3
ntroduction in Statitics with R (L02	86) Lecture	1	1
ntroduction in Statitics with R (L07	76) Recitation Section (large)	1	1
Principles of Geomatics (L0470)	Lecture	2	2
Principles of Geomatics (L0471)	Recitation Section (small)	2	2
Numeric and Matlab (L0125)	Practical Course	2	2
Practical Course in Drinking Water	Chemistry (L1744) Practical Course	1	2
Projects II (L1228)	Project Seminar	2	2
Special topics of Civil- and Environr	nental Engineering (L2411)	1	1
Special topics of Civil- and Environr	nental Engineering 2 LP (L2412)	2	2
Special topics of Civil- and Environr	nental Engineering 3LP (L2413)	3	3
Fire Protection and Prevention (L04	72) Lecture	2	2
Module Responsible	Prof. Peter Fröhle		
Admission Requirements	None		
Recommended Previous	none		
Knowledge			
-	After taking part successfully, students have reached the following learning results		
Professional Competence			
	The students are at home doing with typical applications of the study programme.		
Skills	The students are able to use the methods that are provided during the lectures for practical questions. They are able to work in th learnt methods into new forms of application independently".		
Personal Competence			
	According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly.	in teams. If so	o, they can prese
Social Competence			
Social Competence Autonomy	discuss and document results accordingly.		
Social Competence Autonomy	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		
Social Competence Autonomy Workload in Hours Credit points	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	for themselves	s or for the team.

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

Course L0499: Soil Laborator	ry Course
Тур	Practical Course
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and	Die gesamte Arbeitszeit im Praktikum plus anschließender Bericht = 90 Stunden Arbeitszeit (Das Erstellen der Ausarbeitung =
scale	Bearbeitungszeitraum von 4 Wochen und ein Umfang von maximal 50 Seiten.)
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	Field experiments
	Short lecture on laboratory tests
	soil analysis
	laboratory test
	soil clasification
	Creating a ground and foundation report
Literature	DIN-Taschenbuch 113, Erkundung und Untersuchung des Baugrundes

Course L1903: Building Infor	mation Modeling
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Schriftliche Ausarbeitung
Examination duration and	siehe Modulhandbuch
scale	
Lecturer	Prof. Kay Smarsly
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
СР	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
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	
Cycle	WiSe
Content	 basics of the Finite Element Method, Spreadsheets basics of software 'SOFISTIK' modeling of an arbitrary cross-section modeling of an arbitrary 2D truss structure incl. loads Teddy: usage of global and local variables design of a concrete section modeling of a T-beam bridge by means of a grillage system modeling and design of a rectangular slab building models
Literature	 Vorlesungsunterlagen können im STUDiP heruntergeladen werden Tutorials von SOFiSTiK Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &.Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)

Course L0286: Introduction i	n Statitics with R
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Dr. Joachim Behrendt
Language	DE
Cycle	WiSe
Content	Introduction to R
	Graphics with R
	Descriptive Statistic (Boxplot, Percentiles, outliers)
	Propability (Combinatorics, relative frequency, dependand probability)
	random numbers and distibutions (confidence interval, uniform and discrete distributions, test-distributions (t-F-X ² -distribution))
	Correlation and Regression analysis (Confidence interval of calibration curves, linearity)
	Statistic test procedures (mean value-t-Test, Chi^2-Test, F-Test)
	Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test)
	Introduction time series (tseries)
	Introduction cluster analysis (k-means)
Literature	Regionales Rechenzentrum für Niedersachsen
	Statistik mit R
	Grundlagen der Datenanalyse
	, 2013
	Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld
	http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf
	und die dazugehörige Aufgabensammlung
	http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf
	Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge von Toutenburg, Helge 2008
	http://dx.doi.org/10.1007/978-3-540-77510-2http://dx.doi.org/10.1007/978-3-540-77510-2
	R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran.r-project.org/doc/contrib/Short-refcard.pdf Grafiken und Statistik in R von Andreas Plank
	Nachschlage Skript mit Beispielen: http://www.geo.fu-
	berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdfhttp://www.geo.fu- berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf

ourse L0776: Introduction in Statitics with R	
Тур	Recitation Section (large)
Hrs/wk	1
CP	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	
Hrs/wk	
СР	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	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-verlagWitte, B. / Sparla, P.:Vermessungskunde und Grundlagen der Statistik für das Bauwesen, Wichmann-VerlagGruber, F.J. / Joeckel, R.:Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag

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

Course L0125: Numeric and	Matlab
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Fachtheoretisch-fachpraktische Arbeit
Examination duration and	5 Übungsaufgaben jeweils mit Testat am Ende
scale	
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	 Literatur (Software-Teil): Moler, C., Numerical Computing with MATLAB, SIAM, 2004 The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Course L1744: Practical Course in Drinking Water Chemistry	
Тур	Practical Course
Hrs/wk	1
CP	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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	ca. zehnminütige Präsentation
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	Excursions to different construction and enviromental projects.
Literature	keine

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

Course L2412: Special topics 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, Dr. Jan Mittelstädt	
Language	DE/EN	
Cycle	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

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

Course L0472: Fire Protectio	n 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

TitleTypHrs/wkCPComputer Engineering (L0321)Lecture34	Courses		
anguez proven setup and a setu	Title	Typ Hrs/wk CP	
Metails Responsible for the Non-Fails Admission Requirements Non-Fails Recommended Previous Site Involution in electrical engineering Educational Objective After failing part successfully, students have reached the following learning results Professional Competence The model stude inhibits the following learning results Professional Competence The model stude inhibits the following learning results • introduction • introduction following learning optimical stude includes the following learning results • introduction • introduction following learning results • Combinational logic : filters, automata, systematic introduction, hardware synthesis, combinational networks • Exploring at httms/cl: longer addition, subtraction, multiplication and division • Basics of computer artitited: longer professional adjots, point-bookint connections, butses Skith the students professional division of the anal structure langer addition, subtraction, but physiogence and individual compaties can be able to advision of computer systems. The students can adviso, how highly specific addition and dividual compaties can be able to advision compaties and but advisor analysis, how highly specific addition advisor advisor on the table advisor or advisor, advisor advisor, advisor advi	Computer Engineering (L0321)	Lecture 3 4	
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		 Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations 	
Skits The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the phy compaction 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 disclusuble between and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical composition on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to eval the impact that these low abstraction layers from the assembly language down to gates. This way, they will be enabled to eval 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 acquire new knowledge from specific literature and to associate this knowledge with other classes. Workload in Hours Independent Study Time 124, Study Ti		 Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining Memories: Memory hierarchies, SRAM, DRAM, caches 	
composition of computer systems. The students can analyze, how highly specific and individual computers can be built based 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 com system and the software executed on it. In particular, they shall understand the consequences that the execution of software on the hardware-centric abstraction levels have on an entire system's performance and to propose feasible options. <i>Autonomy</i> Students are able to solve similar problems alone or in a group and to present the results accordingly. <i>Autonomy</i> Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. Workload In Hours For 10% 10% Execution 10% 10% 10% 10% 10% 10% 10% 10% 10% 10%		 Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses 	
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Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: 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 Aircraft Syst			
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General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst		General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory	
		General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical 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 Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha	

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	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 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 M0755: Geote				
Module M0/55: Geote				
Courses				
Title		Тур	Hrs/wk	СР
oundation Engineering (L0552)		Lecture	2	2
Foundation Engineering (L0553)		Recitation Section (large)	2	2
oundation Engineering (L1494)		Recitation Section (small)	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules:			
Knowledge				
	Mechanics I-II			
	Geotechnics I			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students know the basic principles an	nd methods which are required to verificate the sta	bility of geotechni	cal structures.
Skills	After successful completion of the module	e the students are able to:		
	 verificate the stability and usability 	u of foundations		
		d improvement and apply them in their range of ap	alication	
	-	a improvement and apply them in their range of ap	plication,	
	design retaining walls.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	No 20 % Attestation			
Examination	Written exam			
Examination duration and	60 minutes			
scale				
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Civil Engineering	g: Elective Compu	sory
Following Curricula	General Engineering Science (German pro	ogram, 7 semester): Specialisation Civil Engineering	g: Elective Compu	sory
	Civil- and Environmental Engineering: Co	re qualification: Compulsory		
	Civil- and Environmental Engineering: Spo	ecialisation Civil Engineering: Compulsory		
	Civil- and Environmental Engineering: Sp	ecialisation Traffic and Mobility: Elective Compulsor	У	
	Civil- and Environmental Engineering: Sp	ecialisation Water and Environment: Elective Comp	ulsory	
		ogram, 7 semester): Specialisation Civil Engineering		sory
	Technomathematics: Specialisation III. Er			-

Course L0552: Foundation E	ngineering	
Тур	ecture	
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	Accitation Section (small)			
Hrs/wk				
СР	2			
Workload in Hours	ndependent 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			

Module M0728: Hydro	mechar	nics an	d Hydrology				
Courses							
					T	Hara fa alla	65
Fitle					Typ Lecture	Hrs/wk	CP 1
Hydrology (L0909) Hydrology (L0956)					Project-/problem-based Learning	1	2
Hydromechanics (L0615)					Lecture	2	2
Hydromechanics (L0616)					Project-/problem-based Learning	1	1
	Prof. Peter	Frählo			rioject (problem babea zeannig	-	*
•	None	FIOIIIE					
-	Mathemati		J 111				
	Mathemati	cs I, II and					
Knowledge	Mechanics	l und ll					
Educational Objectives	After takin	g part suc	cessfully, students have r	eached the following	ng learning results		
Professional Competence							
Knowledge	The stude	nts are ab	ole to define the basic ter	ms of hydromecha	anics, hydrology groundwater h	ydrology and	water managemen
	They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit- hydrograph.						
Skills	The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Furthermore, they are able to run, explain and document basic hydraulic experiments.						
	Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems.						
			c concepts of field-measu analyze and assess respe	-	gical and hydrodynamic values ts.	can be descri	bed and the studen
Personal Competence							
Social Competence	The students are able to work in groups in a goal-orientated, structured manner. They can explain their results sustainably in plenary sessions by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentations for given topics in groups.						
Autonomy	Students are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline- specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.						
Workload in Hours	Independe	nt Study 1	Fime 110, Study Time in L	ecture 70			
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Group discussion	Hydrologie in	ine Posters zu einer Thema Gruppen und Präsentation	tik aus dem	Themengebiet de
	Yes	None	Excercises	Übungsaufga	ben Hydrologie		
	Yes	None	Subject theoretical practical work	-	g, Dokumentation und Prä nik oder Hydraulik in Gruppen	sentation zu	ı einem Versuch
Examination	Written ex	am					
Examination duration and	150 minute	es					
scale							
	General Fr	aineerina	Science (German program	n. 7 semester): Sn	ecialisation Civil Engineering: Co	ompulsory	
Following Curricula							
. eerring carricula	Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory						
	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory						
	-		nagement - Major in Logis				

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				
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			

Course L0615: Hydromechan	ics				
Тур	Lecture				
Hrs/wk	2				
CP	2				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Prof. Peter Fröhle				
Language	DE				
Cycle	WiSe				
Content	Fundamentals of Hydromechanics				
	Characteristics of fluids				
	Hydrostatics				
	Kinematics of flows, laminar and turbulent flows				
	Conservation laws				
	Conservation of mass				
	Conservation of Energy				
	Momentum Equation				
	Application of conservation laws to flow conditions				
Literature	Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2				
	E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (http://www.tu-harburg.de/ hydraulik_tool/index.html)				
	Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998.				
	Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.				

Course L0616: Hydromechan	ourse L0616: Hydromechanics			
Тур	roject-/problem-based Learning			
Hrs/wk				
CP				
Workload in Hours	independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Peter Fröhle			
Language	DE			
Cycle	NiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M0631: Reinf	orced Concrete	e Structures	; 11			
Courses						
Title Project Concrete Structures II (L089 Concrete Structures II (L0348) Concrete Structures II (L0349)	94)			Typ Project Seminar Lecture Recitation Section (large)	Hrs/wk 1 2 2	CP 1 3 2
Module Responsible	Prof. Günter Rombac	h				
Admission Requirements						
Recommended Previous Knowledge	 Knowledge of Basics of safet Knowledge in the second second	y format are requ design of beams a	and columns for ultir			
Educational Objectives	After taking part suce	cessfully, student	s have reached the f	ollowing learning results		
Professional Competence Knowledge Skills	methods to estimate the member forces in simple one and two-way slabs.					
Personal Competence Social Competence Autonomy	Cooperation in a proj	ect work, where t	they design in a tean	n a real concrete building and p	resent the results at	the end.
Workload in Hours	Independent Study T	ime 110, Study T	ime in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus Yes None	Form Excercises	Descript	ion		
	Written exam					
Examination duration and scale	120 minutes					
Assignment for the	General Engineering	Science (German	program, 7 semeste	er): Specialisation Civil Engineer	ing: Elective Compu	lsorv
Following Curricula	General Engineering Civil- and Environmer Civil- and Environmer Civil- and Environmer Civil- and Environmer	Science (German ntal Engineering: ntal Engineering: ntal Engineering: ntal Engineering:	program, 7 semeste Core qualification: C Specialisation Civil E Specialisation Traffi Specialisation Water	er): Specialisation Civil Engineer	ing: Elective Compu sory npulsory	lsory
Course L0894: Project Concr	ete Structures II					

Course L0894: Project Concrete Structures II			
Тур	roject Seminar		
Hrs/wk			
CP			
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	ctures II
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	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.

Course L0349: Concrete Stru	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 M0579: Struc	tural Design			
Courses				
Courses				
Title	Typ		Hrs/wk	CP 4
Basics in Structural Design (L0209) Basics of Structural Design (L0205)		u Leanning	2	4
Basics in Structural Design (L0208)		rae)	1	1
Module Responsible		. <u></u>	-	
Admission Requirements	None			
Recommended Previous	Contents of module "Principles of Building Materials and Building Physics"			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence	· · · · · · · · · · · · · · · · · · ·			
-	After attending the "Building Construction" module students are able			
	e to define the basics of building you lations law			
	to define the basics of building regulations law			
	 to explain load effects and associated concepts to describe overriding conventions of the construction industry 			
	 to describe overhaing conventions of the construction industry to specify typical building components 			
	 to specify typical building components to distinguish between different possibilities of load bearing behaviour and risk 	r duo to loc	k of stability	
	 to distinguish between uniferent possibilities of load bearing behaviour and risk to explain the main objectivs of fire control. 		K OF SLADIILY	
Skills	After the successful completion of the "Building Construction" module, students will b	e able		
	 to apply industry-specific drawing conventions 			
	 carry out preliminary dimensioning of basic building components 			
	 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			
Autonomy	After attending the course students are able			
	 to control and improve their knowledge with the help of weeekly presentations 	(lecture rec	am) and tosts	
	 to divide the main task in different parts, to deduce the needed knowledge and 			
	• to divide the main task in different parts, to deduce the needed knowledge and	i to schedul	e the unreren	t work steps
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	Desing, Construction and prelimnary design in a written form			
scale				
Assignment for the		neering: Co	mpulsory	
Following Curricula	Civil- and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Civil Engin	neering: Cor	npulsory	

Course L0209: Basics in Stru	ctural Design
Тур	Project-/problem-based Learning
Hrs/wk	
	4
	Independent Study Time 92, Study Time in Lecture 28
	Thomas Kölzer
Language	
Cycle	
Content	
	Constructing a small individuell builling in groups of 4 persons
	 Analysing the informations and the contents of development plans and builling regulation laws
	Design of building components and approving of the funcionality (sealing, facades, roofs)
	Design and approve of the funcionality of the component interconnections
	 Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control
	Assessing the building stability Basics of building convisos
	 Basics of building services Each week the results of different work steps are presented in oral and written form
Literature	Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung
	Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich)
	Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource]
	ISBN: 978-3-8351-9121-1
	Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006
	Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.)
	Baukonstruktionslehre 2 / [Internet-Ressource]
	ISBN: 978-3-8348-9486-1
	Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008
	Dierks, Klaus (Wormuth, Rüdiger.)
	Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer,
	Fenster, Türen, Konstruktionsatlas]
	ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4
	Neuwied : Werner, 2007
	Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus)
	Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROM: Stabwerksprogramm IQ 100 B, Tools für
	den konstr. Ingenieurbau, Fachinformationen, Normentexte]
	ISBN: 3804152287
	Neuwied : Werner, 2006
	Wendehorst, Reinhard (Wetzell, Otto W.,; Baumgartner, Herwig,; Deutsches Institut für Normung)
	Wendehorst Bautechnische Zahlentafeln
	ISBN: 978-3-8351-0055-8 ISBN: 3835100556
	Stuttgart [u.a.] : Teubner Berlin [u.a.] : Beuth, 2007
	Neufert, Ernst (Kister, Johannes)
	Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für
	Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn,
	Lehrenden und Lernenden
	ISBN: 978-3-8348-0732-8 (GB.)
	Wiesbaden : Vieweg + Teubner, 2009

Typ Lacture MN/WK 2 CP 1 Workload In Neurs Independent Study Time 2, Study Time In Lacture 28 Language DF Cytet WGE Basics of building regulation laws • Foundation of buildings • Sealing of basements • Foundation of buildings • Foundation of buildings • Sealing of basements • Cellings • Cellings • Rodes • Cellings • Basics of structural engineering design • Structural for prevention • Optional tests on STUD.IP Vortragsfolien der Lehrvernastaltung stehen über STUD.IP zum download zur Verfügung Schneider Bautbellen (Hrsg. A. Albert) 23, oberarbeitete Aufl. 1SBN 978-3482-0080-9 Reguls Fachmellen GmbH, 2018 Neumann, Dietrich (Hestermann, U.; Rongen, L.; Weinbrenner, U.) Frick/Rold Baukonstructionslehre 2/ (Internet-Ressource) ISBN: 978-3848-0612-0 Imselsaden: Vieweg+Teubner Verlag. 2006 Frick, Otto (Knöll, K.; Neumann, D.; Hestermann, U.; Rongen, L.) Baukonstruktionslehre 2/ (Internet-Ressource) ISBN: 978-3848-061-0 Imselsaden: Vieweg+Teubner Verlag. 2006 Frick, Otto (Knöll, K.; Neumann, D.; Hestermann, U.; Rongen, L.) Baukonstruktinslehre 2/ (Internet-Ress	Course L0205: Basics of Stru	ctural Design
Hrivek 2 CP Image 2 Workload In Hours Independent Study Time 2, Study Time in Lacture 28 Lecture Tomas Kötzer Unguage Diff Cycte Wise Context Basics of building regulation laws - Foundation of buildings - Saaling of basements - Incodes - Collings - Roots - Basics of structural singineering design - Staircasas - Staircasas </th <th></th> <th></th>		
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Workload in Hours Independent Study Time 1, Study Time in Lecture 28 Lecturer Thomas Kölzer Language DE E Content Basics of building regulation laws • Basics of building regulation laws • Sealing of basements • Sealing of basements • Sealing of basements • Iscodes • Cellings • Nords • Windows, doors and post-and-beam constructions • Starcasse • Basics of structural engineering design • Structural file prevention • Optional tests on STUD.IP Vortragsfolien der Lehrveransstlung stehen über STUD.IP zum download zur Verfügung Schneider Bautabelien (Hrsp. A. Albert) 23., überarbeitet Aufl. IDSR 978-34623-0880-90 Reguvis Fachmedien GmbH, 2018 Neumann, Dietrich (Hestermann, U.: Rongen, L.: Weinbrenner, U.) Frick/Möhl Baukonstructionslehre 1 / (Internet-Resource] IDSN: 978-3433-9349-9348-93 Baukonstructuruslehre 2 / Internet-Resource] IDSN: 978-3433-931-912-1 Wiesbaden: Vieweg + Teubner Verlag, 2006 Frick/, Oto (Kroll, K.; Neumann, D.: Hestermann, U.: Rongen, L.) Baukonstruktuon IDSN: 978-34349-9348-61		
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Wendehorst Bautechnische Zahlentafeln		
USBN: 978-3-8351-0055-8		
		ISBN: 978-3-8351-0055-8
Stuttgart/Berlin: Teubner/Beuth, 2018	1	Stuttgart/Berlin: Teupher/Beuth, 2018

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

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	, Chemistry			
Knowledge					
Educational Objectives	After taking part successfully, students	have reached the following learning results			
Professional Competence					
Knowledge	Students are able to define terms of th	ne 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 o				
	well hydraulics. Fundamentals of solute	transport can be reflected.			
Skills	Students are able to use fundamental i	relationships of hydrology and water management	for the solution of r	practical issues. Th	
	are in a position to rate water quality	data and to set up hydrological water balances.	They are able to co	nstruct ground wat	
	contour lines and streamlines on the basis of head data. They have the ability to analyse data of hydraulic field and lab tests to				
	determine hydraulic conductivities and	storage coefficients.			
Personal Competence					
Social Competence	Students are able to help each other so	lving case studies.			
Autonomy	Are not imparted in this module.				
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German p	program, 7 semester): Specialisation Civil Engineer	ing: Elective Compu	lsory	
Following Curricula	Civil- and Environmental Engineering: C	Core qualification: Compulsory			

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	ourse 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	Prof. Nima Shokri, Hannes Nevermann	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0366: Water Manage	ourse L0366: Water Management and Water Quality	
Тур	Lecture	
Hrs/wk	2	
CP	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			
	.	Hara facilia	<u></u>
Fitle Management Tutorial (L0882)	Typ Recitation Section (small	Hrs/wk	СР 3
ntroduction to Management (L088		3	3
Module Responsible	Prof. Christoph Ihl		
Admission Requirements	None		
Recommended Previous	Basic Knowledge of Mathematics and Business		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	After taking this module, students know the important basics of many different areas in and Organisation to Marketing and Innovation, and also to Investment and Controlling. In		
	 explain the differences between Economics and Management and the sub-o important definitions from the field of Management 	disciplines in Manage	ement and to na
	explain the most important aspects of and goals in Management and name the	most important aspe	ects of entreprneu
	projects		
	describe and explain basic business functions as production, procurement a		-
	organization and human ressource management, information management, innov		
	explain the relevance of planning and decision making in Business, esp. in	situations under mu	litiple objectives
	 uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. 		
	• state basics non accounting and costing and selected controlling methods.		
Skills	Students are able to analyse business units with respect to different criteria (organization out an Entrepreneurship project in a team. In particular, they are able to	on, objectives, strateg	jies etc.) and to ca
	analyse Management goals and structure them appropriately		
	analyse organisational and staff structures of companies		
	apply methods for decision making under multiple objectives, under uncertainty a	nd under risk	
	analyse production and procurement systems and Business information systems		
	 analyse and apply basic methods of marketing 		
	 select and apply basic methods from mathematical finance to predefined problem 	15	
	apply basic methods from accounting, costing and controlling to predefined proble	ems	
Personal Competence			
	Students are able to		
	work successfully in a team of students		
	 to apply their knowledge from the lecture to an entrepreneurship project and write 	e a coherent report or	n the project
	 to communicate appropriately and to comport respectfully with their follow students 		
	 to cooperate respectfully with their fellow students. 		
Autonomy	Students are able to		
	 work in a team and to organize the team themselves 		
	 to write a report on their project. 		
	• to write a report on their project.		
Weyldood in House	Independent Chudu Time 110, Chudu Time in Leeture 70		
	Independent Study Time 110, Study Time in Lecture 70		
Credit points			
Credit points Course achievement	None		
Credit points Course achievement Examination	None Subject theoretical and practical work		
Credit points Course achievement Examination Examination duration and	None Subject theoretical and practical work several written exams during the semester		
Credit points Course achievement Examination Examination duration and scale	None Subject theoretical and practical work several written exams during the semester	500/	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compul		
Credit points Course achievement Examination Examination duration and scale	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compute Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Computes	ory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compul Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulse Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Com	ory ompulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compute Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Computes	ory ompulsory	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work General Engineering Science (German program, 7 semester): Core qualification: Compuls Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compuls Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compuls Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Comput Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program)	ory ompulsory ilsory gineering: Compulsory	/
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compuls Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compuls Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Computs Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Comput Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Civil Engineering Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Civil Engineering Engineering Science (English program, 7 semester): Specialisation Civil Engineering Science	ory ompulsory ilsory gineering: Compulsory ring: Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compuls Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compuls Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compuls Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Dioprocess E	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso	iry
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compuls Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compuls Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compuls Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Civil Enginee General Engineering Science (English program, 7 semester): Specialisation Diviprocess E General Engineering Science (English program, 7 semester): Specialisation Bioprocess E General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Bioprocess E	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso inviromental Engineer	iry
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compuls Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compuls Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Core Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Civil Enginee General Engineering Science (English program, 7 semester): Specialisation Bioprocess E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso inviromental Engineer ience: Compulsory	ry ring: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compuls Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compuls Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Core Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Computer Sc General Engineering Science (English program, 7 semester): Specialisation Computer Sc	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso inviromental Engineer ience: Compulsory	ry ring: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulse Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulse Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Bioprocess E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Computer Sci General Engineering Science (English program, 7 semester): Specialisation Computer Sci General Engineering Science (English program, 7 semeste	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso inviromental Engineer ience: Compulsory anical Engineering, I	rry ring: Compulsory Focus Biomechan
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work General Engineering Science (German program, 7 semester): Core qualification: Compulse Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulse Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mecha	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso inviromental Engineer ience: Compulsory anical Engineering, I	rry ring: Compulsory Focus Biomechar
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulse Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulse Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Computer Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering General Engineering Science (English program, 7 semester): Specialisation Bioprocess E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Energy and E General Engineering Science (English program, 7 semester): Specialisation Computer Sci General Engineering Science (English program, 7 semester): Specialisation Computer Sci General Engineering Science (English program, 7 semeste	ory ompulsory ilsory gineering: Compulsory ring: Compulsory ngineering: Compulso inviromental Engineer ience: Compulsory anical Engineering, I ical Engineering, Foo	ry ring: Compulsory Focus Biomechan :us Energy Syste

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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 s 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.

[81]

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

	ary Engineering I				
Courses					
Title		Тур	Hrs/wk	СР	
Wastewater 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	De sie lange date oor Ok envieten oord Diele v				
Knowledge	Basic knowledge on Chemistry and Biology				
	 Hydraulics of pipe systems and open chan 	nels			
	 Basic knowledge on water management: w 	vater quantity and water quality			
	Basic knowledge on Environmental Legisla	tion: Federal Water Act			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence					
Knowledge	The students can examplify their expert knowle	dge on urban water infrastructures. They ca	n present the de	erivation and detail	
5	explanation of important standards for the desig				
	are capable of reproducing the relevant empirica				
	discuss sanitary engineering processes and the				
	existing problems in the field of sanitary enginee				
	draft the features and effectiveness of importan		and low-pressure	e membrane filtrati	
	systems and techniques for the removal of trace	pollutants.			
Skills	The students are able to apply the relevant star	ndards and guidelines for the design and op	eration of urban	water infrastructur	
	independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as th				
	associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve bioche problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of their or				
			able to develop	ideas of their own	
	improve the existing water related infrastructure	s, systems and concepts.			
Personal Competence					
Social Competence	Social skills are not targeted in this module.				
Autonomy	Students are able to form concepts on their ov	in to optimize urban water infractructure n	rocesses Theref	ore they can acqui	
Autonomy					
	appropriate knowledge when being given some	clues of information with regard to the ap	proach to proble	ens (preparation a	
	follow-up of the exercises).				
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale			51 11 0		
-	General Engineering Science (German program,			Isory	
Following Curricula	General Engineering Science (German program,		ies: Compulsory		
	Civil- and Environmental Engineering: Core quality	fication: Compulsory			
	Civil- and Environmental Engineering: Core quality	fication: Compulsory			
	General Engineering Science (English program, 7	semester): Specialisation Civil Engineering:	Elective Compute	sory	
	Green Technologies: Energy, Water, Climate: Cor				

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

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

Module M0869: Hydra	ulic Engineering				
Courses					
Title		Тур	Hrs/wk	СР	
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					
Admission Requirements Recommended Previous	None				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results			
Professional Competence					
Knowledge	Students are able to define the basic terms of hydraulic engin	neering and hydraulics. They are	able to explai	in the application	
	basic hydrodynamic formulations (conservation laws) to practi	ical hydraulic engineering probler	ns. Besides th	is, the students c	
	illustrate important tasks of hydraulic engineering and give an	overview over river engineering,	flood protect	ion, hydraulic pow	
	engineering and waterways engineering.				
Skills	The students are able to apply hydraulic engineering methods	and approaches to basic practica	al problems ar	nd design respecti	
	hydraulic engineering systems. Besides this, they are able to	use and apply established approa	iches of hydra	ulics and determi	
	water surfaces of channel flows, influences of constructions (we	eirs, etc.) on channel flows as well	as flow condit	ions of pipe syste	
	Furthermore, they are able to run, explain and document basic	hydraulic experiments.			
Personal Competence					
	The students are able to deploy their gained knowledge in ap	plied problems. Additionaly, they	will be able t	o work in team w	
	engineers of other disciplines in a goal-orientated, structured manner. They can explain their results by use of peer learnin				
	approaches.				
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems. Furthermore, they are capable				
	organising their individual work flow to contribute to the conduc	ct of experiments and to present of	discipline-spec	ific knowledge.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	Compulsory Bonus Form Description				
	-	-	sentation zu	einem Versuc	
Examination		anik oder Hydraulik			
	The duration of the examination is 2 hours. The examination	includes tasks with respect to	the general u	ndorstanding of t	
scale	lecture contents and calculations tasks.	r includes tasks with respect to	the general a	inderstanding of t	
Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Civil Engineering: Ele	ective Compuls	sorv	
Following Curricula	General Engineering Science (German program, 7 semester): 9				
	Engineering: Elective Compulsory				
	Civil- and Environmental Engineering: Core qualification: Comp	ulsory			
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Elective Compulsory				
	Green Technologies: Energy, Water, Climate: Specialisation Wa	ter: Elective Compulsory			
Course L0957: Hydraulics					
Тур	Lecture				
Hrs/wk					
CP	1 Index and est Study Time 10. Study Time in Lastwee 14				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Peter Fröhle				
Language	WiSe/SoSe				
	Flow of incompressible fluids in pipes and open channels				
Content	now or incompressible nulus in pipes and open channels				
	Hydraulics of pipes				
Punps in hydraulic systems					
	Open channel flow				
	 Open channel flow Regulative construction in open channel flow				
	 Open channel flow Regulative construction in open channel flow Weirs 				
	 Open channel flow Regulative construction in open channel flow Weirs Sliding panels 				
	 Open channel flow Regulative construction in open channel flow Weirs 				
	 Open channel flow Regulative construction in open channel flow Weirs Sliding panels 				

Course L0958: Hydraulics			
Тур	Project-/problem-based Learning		
Hrs/wk	1		
CP	1		
Workload in Hours	prkload 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		

ourse L0960: Hydraulic Engineering				
Тур	roject-/problem-based Learning			
Hrs/wk	1			
СР	2			
Workload in Hours	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 Engineerin	ig and Material Engineering		
Courses				
Title		Тур	Hrs/wk	СР
	ng/Bioprocess Engineering (L0829)	Lecture	2	1
Fundamentals of material engineer	ing (L0830)	Lecture	2	2
Module Responsible	Prof. Michael Schlüter			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	After passing this module the students have t	the ability to:		
	 give an overview of the most importan 	t fields on process and bioprocess engine	erina	
	 explain some working methods for diffe 		ering,	
	• explain some working methods for any	erent news in process engineering.		
Skills	After passing this module the students should	d have the ability to:		
	 list and outline the most important field 		- f	
	 name the most important working app 		of process engineering,	
	read and prepare an engineering draw			
	explain the most important technologie			
	 scheme typical chemical and biotechno 	ological processes independently with the	ald of pointers.	
Personal Competence				
Social Competence	The students are able to			
	 work out results in groups and docume 			
	 provide appropriate feedback and hand 	dle feedback on their own performance co	onstructively.	
Autonomy	The students are able to estimate their prog	gress of learning by themselves and to d	eliberate their lack of k	nowledge in Proces
	Engineering and Bioprocess Engineering.			
Workload in Hours	Independent Study Time 34, Study Time in Le	ecture 56		
Credit points				
Course achievement		Description		
course demovement	No 5 % Written elaboration			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German progra	m. 7 semester): Specialisation Process Fr	aineering: Compulsory	
Following Curricula				irv
y cantouru	Bioprocess Engineering: Core qualification: Co		5 <u>9</u> . compulso	,
	General Engineering Science (English program		Engineering: Compulso	v
	General Engineering Science (English program			3
	Orientierungsstudium: Core qualification: Elec		gineering. compuisory	
	Process Engineering: Core qualification: Com			
	i rocess Engineering. Core qualification: Com	pulsory		

Course L0829: Introduction i	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 Looso: Fundamentais	of material engineering
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	 Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials Ceramic materials Ceramic materials 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					
tle		Тур	Hrs/wk	СР	
omputer Engineering (L0321)		Lecture	3	4	
omputer Engineering (L0324)		Recitation Section (small)	1	2	
Module Responsible	None				
•	Basic knowledge in electrical engineering				
Knowledge					
-	After taking part successfully, students have reach	ed the following learning results			
	e This module deals with the foundations of the functionality of computing systems. It covers the layers from the programming down to gates. The module includes the following topics:				
	 Introduction Combinational logic: Gates, Boolean algebra Sequential logic: Flip-flops, automata, system Technological foundations Computer arithmetic: Integer addition, subtr Basics of computer architecture: Programmi Memories: Memory hierarchies, SRAM, DRAN Input/output: I/O from the perspective of the 	matic hardware design raction, multiplication and division ng models, MIPS single-cycle architectur 4, caches	e, pipelining		
	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 hor 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 of	or in a group and to present the results a	ccordingly.		
Autonomy	Students are able to acquire new knowledge from	specific literature and to associate this k	nowledge with othe	r classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lectur	ro 56			
Credit points	Independent Study Time 124, Study Time in Lectur	2 30			
Course achievement	Compulsory Bonus Form Description				
	Yes 10 % Excercises Written exam				
	90 minutes, contents of course and labs				
scale					
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Computer Scie	nce: Compulsory		
	General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Science (German program, Engineering Science (German program, 7 Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program, 7 and Production: Compulsory	semester): Specialisation Naval Architec semester): Specialisation Electrical Engi semester): Specialisation Electrical Engi semester): Specialisation Energy and En semester): Specialisation Process Engine , 7 semester): Specialisation Mechar , 7 semester): Specialisation Mechan 7 semester): Specialisation Mechanic n, 7 semester): Specialisation Mechanic semester): Specialisation Mechanical Er semester): Specialisation Mechanical Er	ture: Compulsory neering: Compulsory gineering: Compulsory gineering: Compulsory viromental Enginee eering: Compulsory ical Engineering, F al Engineering, Foc nical Engineering, Foc nical Engineering, Focus F ngineering, Focus F	/ pry ring: Compulsory Focus Mechatron focus Biomechan rus Aircraft Syste Focus Materials reoretical Mechan Product Developm	
	General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsor			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
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
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 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

Title		Тур	Hrs/wk	СР		
Biochemistry (L0351)		Lecture	2	2		
Biochemistry (L0728)		Project-/problem-based Learning	1	1		
Microbiology (L0881)		Lecture	2	2		
Microbiology (L0888)		Project-/problem-based Learning	1	1		
Module Responsible	Dr. Paul Bubenheim					
Admission Requirements	None					
Recommended Previous	none					
Knowledge						
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results				
Professional Competence						
Knowledge	At the end of this module the students can:					
	 explain the methods of biological and biochemical research to 	determine the properties of biom	olecules			
	name the basic components of a living organism					
	- explain the principles of metabolism					
	- explain the principles of metabolism					
	- describe the structure of living cells					
	-					
Skills						
Personal Competence						
Social Competence	The students are able,					
	- to gather knowledge in groups of about 10 students					
	- to introduce their own knowledge and to argue their view in discussions in teams					
	- to divide a complex task into subtasks, solve these and to present the combined results					
Autonomy	The students are able to present the results of their subtasks in	a written report				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
	6					
Course achievement						
	Written exam					
	90 min					
scale						
	General Engineering Science (German program, 7 semester): S	necialisation Bioprocess Engineer	ina: Compulso	rv		
-	Bioprocess Engineering: Core qualification: Compulsory	pecialisation proprocess Engineer	ing. compuiso	' J		
	General Engineering Science (English program, 7 semester): Sp	ecialisation Bioprocess Engineerin	a. Compulsor	v		
	Orientierungsstudium: Core qualification: Elective Compulsory	Construction Dioprocess Engilleen	ig. compuisor	J		
	Technomathematics: Specialisation III. Engineering Science: Ele					

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
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		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	'aul Bubenheim		
Language	DE		
Cycle	SoSe		
Content	1. The molecular logic of Life 2. Biomolecules:		
	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	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Neele Meyer-Heydecke
Language	DE
Cycle	SoSe
Content	1. The procaryotic cell
	evolution
	 taxonomy and specific properties of Archaea, Bacteria, and viruses
	structure and properties of the cell
	• growth
	2. Metabolism
	fermentation and anaerobic respiration
	methanogenesis and the anaerobic food chain
	degradation of polymers shareslike strenky
	chemolithotrophy
	3. 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	
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Barbara Klippel
Language	DE
Cycle	SoSe
Content	1. The procaryotic cell
	evolution
	 taxonomy and specific properties of Archaea, Bacteria, and viruses
	structure and properties of the cell
	• growth
	2. Metabolism
	fermentation and anaerobic respiration
	methanogenesis and the anaerobic food chain
	degradation of polymers
	chemolithotrophy
	3. Microorganisms in relation to the environment
	chemotaxis and motility
	Elemental cycle of carbon, nitrogen and sulfur
	 biofilms
	symbiotic relationships
	• extremophiles
	biotechnology
Literature	
	• Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €)
	• Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €)
	• Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag
	• Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der- mikrobiologie.icbm.de/

Courses					
Title			Тур	Hrs/wk	СР
Bioprocess Engineering - Fundame			Lecture	2	3
Bioprocess Engineering- Fundamentals (L0842)			Recitation Section (large)	2	1
Bioprocess Engineering - Fundame	ntal Practical Course (L0843)		Practical Course	2	2
Module Responsible	Prof. Andreas Liese				
Admission Requirements	None				
Recommended Previous	none, module "organic chemistry", module "fundamentals for process engineering"				
Knowledge					
Educational Objectives	After taking part successfully, students have	ve reached the followir	ng learning results		
Professional Competence					
Knowledge	Students are able to describe the basic co	ncepts of bioprocess e	ngineering. They are able to	classify different	types of kinetics
5	enzymes and microorganisms, as well a			-	
	rheology can be named and mass trans				
	fundamental bioprocess management, ste				
Skills	After successful completion of this module	, students should be al	ble to		
	describe different kinetic approache	s for growth and subst	rate-untake and to calculate	the correspondir	a narameters
		-		-	
	 predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the formentation process. 				
	fermentation process				
	 analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations distinguish between scale up criteria for different bioreactors and bioprocesses (apparable acredit ac				
	 distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic to compare them as well as to complet them to current histochaical problem. 				
	to compare them as well as to apply them to current biotechnical problem				
	 propose solutions to complicated biotechnological problems and to deduce the corresponding models to explore new knowledge resources and to apply the newly gained contents 				
	 identify scientific problems with concrete industrial use and to formulate solutions. to document and discuss their procedures as well as results in a scientific manner 				
Personal Competence					
Social Competence	After completion of this module participan	ts should be able to de	ebate technical questions in	small teams to e	nhance the ability
	take position to their own opinions and inc				
			5 5		
Autonomy	After completion of this module participan	ts will be able to solve	e a technical problem in a te	am independentl	y by organizing th
	workflow and to present their results in a	plenum.			
Merkleed in Heure	Independent Chudu Tines OC, Chudu Tines in	Leeture 04			
	Independent Study Time 96, Study Time in	Lecture 84			
Credit points		Description			
Course achievement		Description			
	Yes 5 % Subject theoretic	al and			
Eveningtion	practical work				
	Written exam				
Examination duration and					
Examination duration and scale					
scale	General Engineering Science (German prog	gram, 7 semester): Spe	ecialisation Process Engineer	ring: Compulsory	
scale	General Engineering Science (German prog		-		iry
scale Assignment for the	General Engineering Science (German prog	gram, 7 semester): Spe	-		ory
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog	gram, 7 semester): Spe : Compulsory	ecialisation Bioprocess Engin	eering: Compulso	
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core qualification:	gram, 7 semester): Spe : Compulsory ram, 7 semester): Spe	ecialisation Bioprocess Engin	eering: Compulso	
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core qualification: General Engineering Science (English prog General Engineering Science (English prog	gram, 7 semester): Spe : Compulsory ram, 7 semester): Spe ram, 7 semester): Spe	ecialisation Bioprocess Engin cialisation Bioprocess Engine cialisation Process Engineeri	eering: Compulso eering: Compulsor ng: Compulsory	
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core qualification: General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Arti	gram, 7 semester): Spe : Compulsory ram, 7 semester): Spe ram, 7 semester): Spe ificial Organs and Rege	ecialisation Bioprocess Engin cialisation Bioprocess Engine cialisation Process Engineeri enerative Medicine: Compuls	eering: Compulso eering: Compulsor ng: Compulsory	-
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core qualification: General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Arti Biomedical Engineering: Specialisation Imp	gram, 7 semester): Spe : Compulsory ram, 7 semester): Spe ram, 7 semester): Spe ificial Organs and Rege plants and Endoprosthe	ecialisation Bioprocess Engine cialisation Bioprocess Engine cialisation Process Engineeri enerative Medicine: Compuls eses: Elective Compulsory	eering: Compulso eering: Compulsor ng: Compulsory ory	-
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core qualification: General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Arti Biomedical Engineering: Specialisation Imp Biomedical Engineering: Specialisation Med	gram, 7 semester): Spe : Compulsory ram, 7 semester): Spe ram, 7 semester): Spe ificial Organs and Rege plants and Endoprosthe dical Technology and C	ecialisation Bioprocess Engin cialisation Bioprocess Engine cialisation Process Engineeri enerative Medicine: Compuls eses: Elective Compulsory Control Theory: Elective Com	eering: Compulso eering: Compulsor ng: Compulsory ory pulsory	-
scale Assignment for the	General Engineering Science (German prog General Engineering Science (German prog Bioprocess Engineering: Core qualification: General Engineering Science (English prog General Engineering Science (English prog Biomedical Engineering: Specialisation Arti Biomedical Engineering: Specialisation Imp	gram, 7 semester): Spe compulsory ram, 7 semester): Spe ram, 7 semester): Spe ficial Organs and Rege plants and Endoprosthe dical Technology and C nagement and Busines	ecialisation Bioprocess Engine cialisation Bioprocess Engine cialisation Process Engineeri enerative Medicine: Compuls eses: Elective Compulsory Control Theory: Elective Com is Administration: Elective Com	eering: Compulso eering: Compulsor ng: Compulsory ory pulsory	-

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

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

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

Courses				
Title Fundamentals of Fluid Mechanics (I Fluid Mechanics for Process Engine		Typ Lecture Recitation Section (large)	Hrs/wk 2 2	CP 4 2
Module Responsible				
Admission Requirements	None			
Recommended Previous				
Knowledge	 Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differentia Integration 	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 different types give an overview for different applications of t explain simplifications of the Continuity- and N 	he Reynolds Transport-Theorem in proce		ions
Skills	The students are able to			
Personal Competence	 describe and model incompressible flows math reduce the governing equations of fluid mecha notice the dependency between theory and te use the learned basics for fluid dynamical app 	nics by simplifications to archive quant chnical applications		.g. by integration
Social Competence	The students			
Autonomy	 are capable to gather information from subject of the lecture and able to work together on subject related task (e.g. during small group exercises) are able to work out solutions for exercises by 	s in small groups. They are able to pre	sent their results	effectively in Englis
Autonomy				
	 search further literature for each topic and to work on their exercises by their own and to ev 			
		-		
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture	00		
Course achievement		escription		
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Process Enginee	ring: Compulsory	
Following Curricula	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se Bioprocess Engineering: Core qualification: Compulso Energy and Environmental Engineering: Core qualific General Engineering Science (English program, 7 sen	mester): Specialisation Energy and Envi ory ation: Compulsory	romental Enginee	ring: Compulsory
	General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser Technomathematics: Specialisation III. Engineering S Process Engineering: Core qualification: Compulsory	nester): Specialisation Process Engineer		ing: Compulsory

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	 fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course L0092: Fluid Mechani	ics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Courses				
Title		Tree	Hre /ul/	СР
Phase Equilibria Thermodynamics (0114)	Typ Lecture	Hrs/wk 2	2
Phase Equilibria Thermodynamics (E0114) Phase Equilibria Thermodynamics (L0140)		Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (Recitation Section (large)	1	2
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
	Mathematics, Physical Chemistry, Thermo	dynamics I and II		
Educational Objectives	After taking part successfully, students ha	ve 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, solid) For different phase equilibria, seve knowledge for plotting and interpresent statement of the statement		earn concepts to quant of the second se	antitatively descri omena may occu quilibria are taugh n and the necessa
	 state and know how to simplify thes The students know models which care able to solve the resulting math For specific applications, they are a model parameters in literature sour Beside pure compound properties th The students know how to visualize 	an be used to determine the properties of the s mematical relations. where the self-reliantly find necessary physico-cherr ces. The students are capable of describing the proper phase equilibria graphically and they know how tudents are able to understand fundamental	ystem in the equilil nical properties of co ties of mixtures. to interpret the occ	orium state and th ompounds as well urring phenomena
Personal Competence				
Social Competence	The students are able to work in small gr other students	oups, to solve the corresponding problems and	to present them or	ary to the tutors a
Autonomy	• The students are able to find neces	sary information self-reliantly in literature source are able to check their learning progress co their learning process.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement				
Examination	Written exam			
	120 minutes; theoretical questions and ca	Iculations		
Assignment for the Following Curricula		gram, 7 semester): Specialisation Process Engine gram, 7 semester): Specialisation Bioprocess Eng		ory
	Bioprocess Engineering: Core qualification General Engineering Science (English prog	: Compulsory gram, 7 semester): Specialisation Bioprocess Eng gram, 7 semester): Specialisation Process Engine	ineering: Compulso	

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

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

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

Courses				
Title	Тур		Hrs/wk	СР
Signals and Systems (L0432) Signals and Systems (L0433)	Lecture	re ation Section (small)	3 2	4 2
Module Responsible		cion beccion (sindily	L.	_
Admission Requirements				
Recommended Previous				
Knowledge				
	The modul is an introduction to the theory of signals and systems. Good	-	-	
	1-3 is expected. Further experience with spectral transformations (Fou	urier series, Fourier trans	form, Laplace	transform) is use
	but not required.			
Educational Objectives	After taking part successfully, students have reached the following learn	ning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and linear time-ir	invariant (LTI) systems us	ing methods of	f signal and syst
	theory. They are able to apply the fundamental transformations of con		-	-
	can describe and analyse deterministic signals and systems mathema			
	understand the effects in time domain and image domain which are	caused by the transition	n of a continuo	us-time signal t
Skille	discrete-time signal. The students are able to describe and analyse deterministic signals and	d linear time invariant sv	stoms using m	othods of signal
JKIIIS	system theory. They can analyse and design basic systems regardi		-	-
	response, stability, linearity etc They can assess the impact of LTI syste			
Personal Competence	······································			
	The students can jointly solve specific problems.			
	The students are able to acquire relevant information from approp	priate literature sources	. They can co	ntrol their leve
	knowledge during the lecture period by solving tutorial problems, softwa	are tools, clicker system.		
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				
	General Engineering Science (German program, 7 semester): Core quali	lification: Compulsory		
Following Curricula				
	Data Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisati	tion Electrical Engineering	: Compulson	
	General Engineering Science (English program, 7 semester): Specialisati			/
	General Engineering Science (English program, 7 semester): Specialisati			
	General Engineering Science (English program, 7 semester): Spec			ocus Biomechar
	Compulsory			
	General Engineering Science (English program, 7 semester): Specia	alisation Mechanical Eng	ineering, Focu	s Energy Syste
	Compulsory			
	General Engineering Science (English program, 7 semester): Specia	alisation Mechanical Eng	jineering, Focu	s Aircraft Syste
	Engineering: Compulsory	tion Mashaniash Fasting at	Mate	uists in Environ
	General Engineering Science (English program, 7 semester): Specialisat Sciences: Compulsory	tion Mechanical Engineeri	ing, Focus Mate	in Enginee
	General Engineering Science (English program, 7 semester): Spec	cialisation Mechanical F	naineerina Fo	ocus Mechatror
	Compulsory		ingineering, in	
	General Engineering Science (English program, 7 semester): Specialisat	ation Mechanical Enginee	ring, Focus The	oretical Mechan
	Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisati	tion Process Engineering:	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisati	-	ng: Compulsory	/
	Computational Science and Engineering: Core qualification: Compulsory	Ý		
	Mechatronics: Core qualification: Compulsory	ompulsory		
	Technomathematics: Specialisation III. Engineering Science: Elective Con	JIIIpulsory		
Course L0432: Signals and S	vstems			
Ţ	Lecture			
Typ				
Hrs/wk	3			

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 function
 - Crosscorrelation 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

Module M0892: Chem	ical Reaction Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Chemical Reaction Engineering (Fundamentals) (L0204)		Lecture	2	2
Chemical Reaction Engineering (Fundamentals) (L0244)		Recitation Section (large)	2	2
Experimental Course Chemical Eng	ineering (Fundamentals) (L0221)	Practical Course	2	2
Module Responsible	Prof. Raimund Horn			
Admission Requirements	None			
Recommended Previous	Contents of the previous modules mathematics I-III, physical chemistry, technical thermodynamics I+II as well as computation			ell as computationa
Knowledge	methods for engineers.			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences betwee			differences betweer
	thermodynamical and kinetical processes. The	students have a strong ability to outline part	rts of isotherma	and non-isotherma
	ideal reactors and to describe their properties.			
Skills	After successful completion of the module, stude	ents are able to:		
	- apply different computational methods to dime	ension isothermal and non-isothermal ideal rea	actors,	
	- determine and compute stable operation points for these reactors ,			
	- conduct experiments on a lab-scale pilot plants	and document these according to scientific g	juidelines.	
Personal Competence				
Social Competence	After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve			
	issues in chemical reaction engineering. The s	tudents can discuss their subject related kno	wledge among	each other and wit
	their teachers.			
Autonomy	The students are able to obtain further info	ormation and assess their relevance auton	omously. Studer	nts can apply thei
	knowldege discretely to plan, prepare and condu	uct experiments.		
Workload in Hours	Independent Study Time 96, Study Time in Lecto	ure 84		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes None Subject theoretical a	and		
	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	eering: Compulso	iry
	Bioprocess Engineering: Core qualification: Compulsory			
	General Engineering Science (English program,	7 semester): Specialisation Bioprocess Engine	ering: Compulsoi	У
	General Engineering Science (English program,	7 semester): Specialisation Process Engineerir	ig: Compulsory	
	Green Technologies: Energy, Water, Climate: Sp	ecialisation Bioresource Technology: Elective	Compulsory	
	Process Engineering: Core qualification: Compul	sory		

Course L0204: Chemical Reac	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	
	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures) Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions) Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers) Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-	

	equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre- equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics) Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors) Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of 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 Reaction Engineering (Fundamentals)		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup	
Language	DE	
Cycle	WiSe	
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, 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 the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance of a cascade of tank reactors, numerical- interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)
	non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)
Literature	lecture notes Raimund Horn
	skript Frerich Keil
	Books:
	M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	G. Emig, E. Klemm, Technische Chemie, Springer
	A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
	E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
	J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
	H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
	H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
	O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
	L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
	J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
	R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
	M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
	G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
	A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

Course Chemical Engineering (Fundamentals)
Practical Course
2
2
Independent Study Time 32, Study Time in Lecture 28
Prof. Raimund Horn
DE/EN
SoSe
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.
Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB)
Praktikumsskript
Skript Chemische Verfahrenstechnik 1 (F.Keil)

Madula M1075, Envir	an mantal Task				
Module M1275: Envir	onmental lech	nology			
Courses					
Title			Тур	Hrs/wk	СР
Practical Exercise Environmental T	echnology (L1387)		Practical Course	1	1
Environmental Technologie (L0326	,)		Lecture	2	2
Module Responsible	Prof. Martin Kaltschm	nitt			
Admission Requirements	None				
Recommended Previous	Fundamentals of inor	rganic/organic chemistry	and biology		
Knowledge					
Educational Objectives	After taking part succ	cessfully, students have r	reached the following learning results		
Professional Competence					
Knowledge	With the completion	of this modul the student	ts obtain profound knowledge of environme	ntal technology. They	are able to descri
	the behaviour of che	micals in the environme	nt. Students can give an overview of scient	tific disciplines involv	ed. They can expl
	terms and allocate th	nem to related methods.			
Skills			anagement and mitigation measures for e		
	-		ssess the potential of pollutants to migrate		
		•	onmental Technology contributes to sustain	nable development, a	ind 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-s	pecific and multidisci	olinary. They are a
	to develop different a	approaches to the task as	s a group as well as to discuss their theoreti	cal or practical imple	mentation.
Autonomy	Students can indeper	ndently exploit sources a	bout of the subject, acquire the particular k	nowledge and tranfer	it to new problem
Workload in Hours	Independent Study T	ime 48, Study Time in Le	ecture 42		
Credit points	3				
Course achievement		Form	Description		
	Yes None	Subject theoretical	and		
		practical work			
Examination					
Examination duration and	1 hour				
scale					
Assignment for the	General Engineering	Science (German program	m, 7 semester): Specialisation Process Engi	neering: Elective Com	pulsory
Following Curricula			m, 7 semester): Specialisation Bioprocess E		
			m, 7 semester): Specialisation Energy and E	Enviromental Enginee	ring: Compulsory
	Diangacase Engineeri	ing: Core qualification: Ele			
	Energy and Environm	nental Engineering: Core	qualification: Compulsory		
	Energy and Environm General Engineering	nental Engineering: Core Science (English progran	qualification: Compulsory n, 7 semester): Specialisation Bioprocess Er		
	Energy and Environm General Engineering General Engineering	nental Engineering: Core Science (English progran Science (English progran	qualification: Compulsory n, 7 semester): Specialisation Bioprocess Er n, 7 semester): Specialisation Energy and E	nviromental Engineer	ng: Compulsory
	Energy and Environm General Engineering General Engineering General Engineering	nental Engineering: Core Science (English progran Science (English progran	qualification: Compulsory n, 7 semester): Specialisation Bioprocess Er n, 7 semester): Specialisation Energy and E n, 7 semester): Specialisation Process Engin	nviromental Engineer	ng: Compulsory

Course L1387: Practical Exercise Environmental Technology		
Practical Course		
1		
1		
Independent Study Time 16, Study Time in Lecture 14		
Prof. Martin Kaltschmitt, Dr. Isabel Höfer		
DE		
SoSe		
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.		

п

Course L0326: Environmenta	l Technologie
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, 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)

6				
Courses				
Title Bioprocess Engineering - Advanced	(11107)	Тур	Hrs/wk	СР
Bioprocess Engineering - Advanced Bioprocess Engineering - Advanced		Lecture Recitation Section (small)	2	4 2
Module Responsible			_	_
Admission Requirements	None			
Recommended Previous	Content of module "Biochemical Engineering I"			
Knowledge				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, stud	dents should be able to		
	describe and explain different kinetic applies	proaches for growth and substrate-uptake		
	identification of scientific problems with	concrete industrial use (cultivation of microor	ganisms and mai	mmalian cells)
	 describe and explain important downs methods 	treaming steps for proteins and their applica	ation as well as	basic immobilizat
Skills	After successful completion of this module, stud	dents should be able to		
	- to identify scientific questions or possit microorganisms and animal cells) and to formu		rial applications	s (eg cultivation
	- To assess the application of scale-up criteria f problems (anaerobic , aerobic or microaerobica		s and to apply th	nese criteria to giv
	- to formulate questions for the analysis and op	timization of real biotechnological production	processes approp	oriate solutions ,
	 To describe the effects of the energy general behavior of microorganisms and to the total fer 		ts , and the gro	wth inhibition of t
	- Establish material flow balance equations an calculate immobilization and activity yields ,	d solve them to determine the kinetic param	eters of differen	nt approaches and
	- to select process control strategies (batch , fe	d-batch , continuity) appropriately and to cal	culate basic type	s and evaluate the
Personal Competence				
Social Competence	After completion of this module participants sh take position to their own opinions and increase		small teams to e	nhance the ability
Autonomy	After completion of this module participants are able to aquire new sources of knowledge and apply their knowledge to previou unknown issues and to present these.			
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	90 min			
scale				
-	General Engineering Science (German program		eering: Compulso	ory
Following Curricula	Bioprocess Engineering: Core qualification: Con		erina: Compulso	D/
	General Engineering Science (English program, Green Technologies: Energy, Water, Climate: Sp			' y
	e.ee., reenhologies, Energy, water, chillate, s	secandation bioresource rechnology. Elective	compaisory	

Course L1107: Bioprocess Er	ngineering - 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 Er	ngineering - Advanced
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. An-Ping Zeng
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				
Fitle		Тур	Hrs/wk	СР
ntroduction to Control Systems (L	0654)	Lecture	2	4
ntroduction to Control Systems (L	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and freque	ency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	 Students can represent dynamic system behavior 	in time and frequency domain, and	can in particular	explain properties
	first and second order systems			
	They can explain the dynamics of simple control to root locure	pops and interpret dynamic propertie	es in terms of free	quency response a
	root locusThey can explain the Nyquist stability criterion and	the stability margins derived from it	ŀ	
	 They can explain the role of the phase margin in a 			
	They can explain the way a PID controller affects a			
	They can explain issues arising when controllers d	esigned in continuous time domain a	re implemented	digitally
Skills				
Shino	Students can transform models of linear dynamic s		ain and vice vers	a
	They can simulate and assess the behavior of syst They can also a plan and assess the behavior of syst			
	 They can design PID controllers with the help of he They can analyze and synthesize simple control lo 			e techniques
	They can calculate discrete-time approximation			
	implementation	5		5
	They can use standard software tools (Matlab Cont	rol Toolbox, Simulink) for carrying ou	ut these tasks	
Personal Competence				
-	Students can work in small groups to jointly solve technic	al problems, and experimentally vali	idate their contro	ller designs
Autonomy				
	when solving given problems.			
	55 1 1 1 1			
		and thereby control their learning pro	aress	
	They can assess their knowledge in weekly on-line tests a	and thereby control their learning pro	ogress.	
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	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56	and thereby control their learning pro	ogress.	
Credit points	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6	and thereby control their learning pro	ogress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None	and thereby control their learning pro	ogress.	
Credit points Course achievement Examination	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	and thereby control their learning pro	ogress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	and thereby control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes		ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min	ter): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests a Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory	ter): Core qualification: Compulsory	ogress.	
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ĺ	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 equationsTustin 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	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Courses				
Title Thermal Separation Processes (L01	18)	Typ Lecture	Hrs/wk 2	CP 2
Thermal Separation Processes (LOI		Recitation Section (small)	2	2
Thermal Separation Processes (L01		Recitation Section (large)	1	1
Separation Processes (L1159)		Practical Course	1	1
Module Responsible	Prof. Irina Smirnova			
Admission Requirements	None			
Recommended Previous	Recommended requirements: Thermodynamics III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can distinguish and describe of	lifferent types of separation processes	such as distillat	tion extraction
	adsorption	include types of separation processes	Such us distinu	lion, extraction,
	 The students develop an understanding for the 	e course of concentration during a sepa	aration process, t	the estimation of
	energy demand of a process, the possibilities of			
	They have good knowledge of designing meth		-	
Skills				
	Using the gained knowledge the students can		or a given separa	tion process and
	close the associated energy and material bala			ofine the energy
	 The students can use different graphical me the control of the processing description. 	thods for the designing of a separatio	n process and d	enne the amoun
	theoretical stages required			
	• They can select and design a basic type of	thermal separation process for a given	case based on	the advantages
	disadvantages of the process			
	The students are capable to obtain independent	ently the needed material properties fro	m appropriate so	ources (diagrams
	tables)			
	 They can calculate continuous and discontinuous 	ous processes		
	 The students are able to prove their theoretical 			
	 The students are able to discuss the theoretic 	al background and the content of the ex	perimental work	with the teacher
	colloquium.			
	The students are capable of linking their gained know	ledge with the content of other lectures	and use it togeth	her for the solutio
	technical problems. Other lectures such as thermody	-	-	
			5	
Personal Competence				
Social Competence				
Social Competence	The students can work technical assignments	in small groups and present the combine	d results in the t	utorial
	The students are able to carry out practical I	ab work in small groups and organize a	functional divisi	ion of labor betw
	them. They are able to discuss their results an	d to document them scientifically in a re	port.	
Autonomy	• The students are capable to obtain the people	information from suitable sources by th	omcolves and as	cocc their quality
	The students are capable to obtain the needed The students are proof the state of their live			
	The students can proof the state of their kn	lowledge with exam resembling assign	iments and in tr	iis way control t
	learning process			
		-		
	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and	120 minutes; theoretical questions and calculations			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering Science (German program, 7 se	mester): Specialisation Bioprocess Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 se	mester): Specialisation Green Technolog	ies, Focus Renew	able Energy: Elec
	Compulsory			
	General Engineering Science (German program, 7 se	mester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory
	Bioprocess Engineering: Core qualification: Compulso	iry		
	Energy and Environmental Engineering: Core qualific	ation: Elective Compulsory		
	General Engineering Science (English program, 7 sen	nester): Specialisation Bioprocess Engine	ering: Compulso	ry
	General Engineering Science (English program, 7 sen	nester): Specialisation Energy and Enviro	mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 sen			
	Green Technologies: Energy, Water, Climate: Special			
	Green Technologies: Energy, Water, Climate: Special	sation Bioresource Technology: Elective	Compulsorv	

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

Тур	Recitation Section (small)
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Irina Smirnova
Language	
Cycle	
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Entrative and exective a distillation water water water and initiality in the second second
	 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 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 198-Ullmann"s Enzyklopädie der Technischen Chemie

Tvp	Recitation Section (large)
Hrs/wk	
CP	
-	- 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 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 198-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
Content	takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They
	receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Module M0538: Heat	and Mass Transfer
Courses	
Title	Typ Hrs/wk CP
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	None
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynamics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Skills	 The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e heat exchanger, chemical reactors). They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, h transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and to describe mass trans qualitative and quantitative by using suitable mass transfer theories. They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail. The students are able to set reasonable system boundaries for a given transport problem by using the gained knowled and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in flui and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transfion and mass transfer. They can use this knowled for the description and design of apparatus (e.g. extraction column, rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a spec application considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and on-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete techn problems.
Personal Competence Social Competence	 The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasona manner to tutors and other students.
Autonomy	 The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (click system, exam-like assignments) and on this basis they can control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	
Examination	Written exam
	120 minutes; theoretical questions and calculations
	בצל והוותננס, נווכסיבנוכמו קעבסנוסווס מוזע כמוכטומנוסווס
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	Green Technologies: Energy, Water, Climate: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective 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

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 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
Environmental Assessment (L0860)		Lecture	2	2
Environmental Assessment (L1054)		Recitation 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 reac	hed the following learning results		
Professional Competence				
Knowledge	With the completion of this module the stude environmental problems which might occur from about the methodological diversity and are comp impacts. Besides the students are able to estima difficulties with their measurement.	production processes, projects or constructed etent in dealing with different methods and	tion measures.	They have knowled assess environment
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 carr out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolover 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 techn to develop jointly different solutions and to dis- topics, the students receive insights into the mul Their sensitivity and consciousness towards the social responsibilities in their role as engineers.	cuss their theoretical or practical impleme ti-layered issues of the environment protect	ntation. Due to tion and the con	the selected lectu cept of sustainabili
Autonomy	The students learn to research, process and process scientific work. They can solve an environmental			
Workload in Hours	Independent Study Time 48, Study Time in Lectur	e 42		
Credit points				
Course achievement				
Examination				
Examination duration and scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Process Engineer	ing: Elective Cor	npulsory
5	General Engineering Science (German program, 7		5	
	General Engineering Science (German program, 7			
	Bioprocess Engineering: Core qualification: Electiv	ve Compulsory		
	Energy and Environmental Engineering: Core qua	lification: Compulsory		
	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Engine	ering: Elective C	Compulsory
	General Engineering Science (English program, 7 General Engineering Science (English program, 7			

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	
Content	Contaminants: Impact- and Risk Assessment
	Environmental damage & precautionary principle: Environmental Risk Assessment (ERA)
	Resource and water consumption: Material flow analysis
	Energy consumption: Cumulated energy demand (CED), cost analysis
	Life cycle concept: Life cycle assessment (LCA)
	Sustainability: Comprehensive product system assessment , SEE-Balance
	Management: Environmental and Sustainability management (EMAS)
	Complex systems: MCDA and scenario method
Literature	Foliensätze der Vorlesung
	Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH)

Course L1054: Environmenta	I Assessment
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Kaltschmitt, Dr. Anne Rödl
Language	DE
Cycle	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
Particle Technology I (L0434)				Lecture	2	3
Particle Technology I (L0435)				Recitation Section (small)	1	1
Particle Technology I (L0440)				Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich	ו				
Admission Requirements	None					
Recommended Previous	keine					
Knowledge						
Educational Objectives	After taking part suc	ccessfully, students l	have reached the follow	ing learning results		
Professional Competence						
Knowledge	After successful com	npletion of the modu	le students are able to			
	 name and exit 	nlain processes and	unit-operations of solid	s process opginoering		
			tributions and to discus			
		particles, particle dis		s their buck properties		
Skills	Students are able to)				
	choose and design apparatuses and processes for solids processing according to the desired solids properties of the produ					
	 asses solids with respect to their behavior in solids processing steps document their work scientifically. 					
	 document the 	eir work scientifically				
Personal Competence						
Social Competence	The students are a	ble to discuss scien	tific topics orally with	other students or scientific p	personal and to o	develop solutions f
	technical-scientific issues in a group.					
Autonomy	Students are able to	analyze and solve o	uestions regarding soli	d particles independently.		
Workload in Hours	Independent Study	Time 110, Study Tim	e in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Written elaborati	on sechs Berich	ite (pro Versuch ein Bericht) à	a 5-10 Seiten	
Examination	Written exam					
Examination duration and	90 minutes					
scale						
Assignment for the	General Engineering	g Science (German p	rogram, 7 semester): S	pecialisation Process Engineer	ring: Compulsory	
Following Curricula	General Engineering	g Science (German p	rogram, 7 semester): S	pecialisation Bioprocess Engin	eering: Compulso	ory
	General Engineering	g Science (German p	rogram, 7 semester): S	pecialisation Energy and Envir	omental Enginee	ring: Compulsory
	General Engineering	g Science (German p	orogram, 7 semester): 9	Specialisation Green Technolo	gies, Focus Wate	r and Environment
	Engineering: Elective Compulsory					
	Bioprocess Engineering: Core qualification: Compulsory					
	Energy and Environ	mental Engineering:	Core qualification: Elect	tive Compulsory		
	General Engineering	science (English pr	ogram, 7 semester): Sp	ecialisation Bioprocess Engine	eering: Compulso	ry
	General Engineering	Science (English pr	ogram, 7 semester): Sp	ecialisation Energy and Enviro	omental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory					
	General Engineering	g Science (English pr	ogram, 7 semester): Sp	ecialisation Process Engineeri	ng: Compulsory	
				ecialisation Process Engineeri ter: Elective Compulsory	ng: Compulsory	

Course L0434: Particle Techr					
Тур	Lecture				
Hrs/wk					
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	ecitation Section (small)	
Hrs/wk		
CP		
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	e See interlocking course	

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

Courses						
Title				Тур	Hrs/wk	СР
Process and Plant Engineering I (L0095)				Lecture	2	2
Process and Plant Engineering I (L0096)				Recitation Section (large)	1	2
Process and Plant Engineering I (L1214)				Recitation Section (small)	1	2
Module Responsible	Prof. Mirko Skiborows	ki				
Admission Requirements	None					
Recommended Previous	unit operation of ther	mal an dmechanical se	paration processes			
Knowledge	chemical reactor eingineering					
Educational Objectives	After taking part succ	essfully, students have	reached the followin	g learning results		
Professional Competence	510	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		5		
	students can:					
	classify and formulate	e blobal balance equation	ons of chemical proce	esses		
	specify linear compor	nent equations of comp	lex chemical process	es		
	explain linear regress	ion and data reconcillia	tion problems			
	explain pfd-diagrams					
Skills	- formulation of mass and energy balance equations and estimation of product streams					
				on of product streams		
	- solution of data reco		cal plants using linea		5	
	- conduction of proces					
	- economic evaluation of processes and the estimation of production costs					
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Ti	me 124, Study Time in	Lecture 56			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 10 %	Subject theoretical	and			
		practical work				
Examination						
Examination duration and scale	120 Min. lectures not	es and books				
Assignment for the	General Engineering	Science (German progra	am, 7 semester): Spe	cialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering	Science (German progra	am, 7 semester): Spe	cialisation Bioprocess Engin	eering: Compulso	ory
	Bioprocess Engineering	ng: Core qualification: C	Compulsory			
	General Engineering	Science (English progra	m, 7 semester): Spec	cialisation Bioprocess Engine	ering: Compulso	у
	General Engineering	Science (English pro	gram, 7 semester):	Specialisation Energy and	Enviromental E	ngineering: Elect
	Compulsory					
				cialisation Process Engineeri		
				source Technology: Elective	Compulsory	
	Process Engineering:	Core qualification: Com	pulsory			

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

Course L1214: Process and P	ourse L1214: Process and Plant Engineering I		
Тур	Recitation Section (small)		
Hrs/wk			
CP			
Workload in Hours	ndependent 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	The Hardwise CD
Fitle Management Tutorial (L0882)	Typ Hrs/wk CP Recitation Section (small) 2 3
ntroduction to Management (L088	
Module Responsible	Prof. Christoph Ihl
Admission Requirements	None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Plan and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	 explain the differences between Economics and Management and the sub-disciplines in Management and to r important definitions from the field of Management
	• explain the most important aspects of and goals in Management and name the most important aspects of entreprise
	projects
	describe and explain basic business functions as production, procurement and sourcing, supply chain managen
	organization and human ressource management, information management, innovation management and marketing
	 explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives uncertainty, and explain some basic methods from mathematical Finance
	 state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to out an Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately
	analyse organisational and staff structures of companies
	apply methods for decision making under multiple objectives, under uncertainty and under risk
	analyse production and procurement systems and Business information systems
	analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems
	 apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
	work successfully in a team of students
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	 to communicate appropriately and to cooperate respectfully with their fellow students.
	• to cooperate respectruity with their renow students.
Autonomy	Students are able to
	 work in a team and to organize the team themselves
	 to write a report on their project.
Workload in Usura	Independent Study Time 110. Study Time in Lecture 70
	Independent Study Time 110, Study Time in Lecture 70
	6
Credit points	
Credit points Course achievement	None
Credit points Course achievement Examination	None Subject theoretical and practical work
Credit points Course achievement Examination Examination duration and	None Subject theoretical and practical work several written exams during the semester
Credit points Course achievement Examination Examination duration and scale	None Subject theoretical and practical work several written exams during the semester
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Credit points Course achievement Examination Examination duration and scale	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General E
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
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Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation: Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (En

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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 s 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	o Management
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management. Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, 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 taspects 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.

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	CP
Circuit Theory (L0566)		Lecture	3 2	4
Circuit Theory (L0567)		Recitation Section (small)	Z	Z
Module Responsible	Prof. Alexander Kölpin			
Admission Requirements				
	Electrical Engineering I and II, Mathematics I and II			
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students are able to explain the basic methods for c	- ,		-
	networks driven by periodic signals. They know the			
	domain, and they are able to explain the frequency be	ehaviour and the synthesis of passive tw	o-terminal-circu	ts.
Skills	The students are able to calculate currents and vol			
	periodic signals. They are able to calculate transients			
	respective transient behaviour. They are able to an	alyse and to synthesize the frequency	behaviour of p	assive two-terminal-
	circuits.			
Personal Competence				
Social Competence	Students work on exercise tasks in small guided gr	oups. They are encouraged to present	and discuss the	eir results within the
	group.			
Autonomy	The students are able to find out the required method	de for colving the given practice probler	ne Bossibilitios	re given to test their
Autonomy	The students are able to find out the required method knowledge during the lectures continuously by me			
	educational objectives. They can link their gained kno			
	educational objectives. They can link their gamea kno	wheage to other courses like Electrical E	ingineering runu	Hutlendies I.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70		
Credit points				
Course achievement				
	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Mechanica	I Engineerina.	Focus Mechatronics
Following Curricula			,	
-	General Engineering Science (German program, 7 sen	nester): Specialisation Electrical Enginee	ering: Compulsor	у
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program, 7 sem	ester): Specialisation Electrical Engineer	ring: Compulsory	,
	General Engineering Science (English program, 7	semester): Specialisation Mechanica	I Engineering,	Focus Mechatronics
	Compulsory			
	Computational Science and Engineering: Specialisatio	n II. Mathematics & Engineering Science	e: Elective Comp	ulsory
	Computational Science and Engineering: Specialisatio	n Engineering Sciences: Elective Compu	llsory	
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Sc	ience: 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	irse 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			
Cycle	WiSe		
Content	see interlocking course		
Literature	siehe korrespondierende Lehrveranstaltung		
	see interlocking course		

Courses				
itle		Tun	Hrs/wk	СР
Computer Engineering (L0321)		Typ Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
	5 5 5			
Knowledge				
Educational Objectives	51	e following learning results		
Professional Competence	This module deals with the foundations of the function	ality of computing systems. It caves	is the lowers from	a tha accomply l
	programming down to gates. The module includes the fo			in the assertiony i
	 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 model 	hardware design n, multiplication and division		works
	Memories: Memory hierarchies, SRAM, DRAM, cac	hes		
	 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 archit composition of computer systems. The students can and collection of few and simple components. They are able today's computing systems - from gates and circuits up to	alyze, how highly specific and individue to distinguish between and to expl	ual computers ca	n be built based
	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 asset the impact that these low abstraction levels have on an	ney shall understand the consequence embly language down to gates. This	es that the exect way, they will be	ution of software enabled to eval
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 specif	ic literature and to associate this kno	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	Compulsory Bonus Form Description Yes 10 % Excercises Excercises	iption		
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ster): Specialisation Computer Scienc	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semes	ster): Specialisation Bioprocess Engin	eering: Compulso	ory
	General Engineering Science (German program, 7 semes	ster): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 semes			
	General Engineering Science (German program, 7 semes		-	ring: Compulsory
	General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 s			Focus Mechatror
	Compulsory			
	General Engineering Science (German program, 7 s Compulsory	emester): Specialisation Mechanica	l Engineering, F	ocus Biomechai
	General Engineering Science (German program, 7 se Engineering: Compulsory			
	General Engineering Science (German program, 7 Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 seme Engineering: Compulsory General Engineering Science (German program, 7 seme		-	
	and Production: Compulsory General Engineering Science (German program, 7 sei	-	-	
	Compulsory General Engineering Science (German program, 7 set			
	Seneral Engineering Selence (Sennan program) / Se			
	Compulsory General Engineering Science (German program, 7 semes	ster): Specialisation Civil Engineering:	Compulsory	
	Compulsory	ster): Specialisation Civil Engineering:	Compulsory	
	Compulsory General Engineering Science (German program, 7 semes Computer Science: Core qualification: Compulsory	ster): Specialisation Civil Engineering:	Compulsory	
	Compulsory General Engineering Science (German program, 7 semes Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory			
	Compulsory General Engineering Science (German program, 7 semes Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory	ter): Specialisation Electrical Enginee ter): Specialisation Civil Engineering:	ring: Compulsory Compulsory	

Course L0321: Computer Eng	jineering	
Тур	Lecture	
Hrs/wk		
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE/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
Electrical Machines and Actuators Electrical Machines and Actuators		Lecture Recitation Section (large)	3 2	4 2
Module Responsible		Rectation Section (large)	Z	2
Admission Requirements	None			
Recommended Previous	Basics of mathematics, in particular complexe	numbers integrals differentials		
Knowledge	busies of mathematics, in particular complexe	numbers, integrais, uncrentiais		
	Basics of electrical engineering and mechanica	l engineering		
Educational Obiectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence		5 5		
-	Students can to draw and explain the basic pri	inciples of electric and magnetic fields.		
	They can describe the function of the stan	dard types of electric machines and pres	ent the correspon	ding equations a
	characteristic curves. For typically used drives	they can explain the major parameters of the	e energy efficiency	of the whole syste
	from the power grid to the driven engine.			
Skills	Students arw able to calculate two-dimension	al electric and magnetic fields in particular f	erromagnetic circu	uits with air gap. F
	this they apply the usual methods of the design	n auf electric machines.		
	They can calulate the operational performanc	e of electric machines from their given char	acteristic data and	d selected quantiti
	and characteristic curves. They apply the usua	l equivalent circuits and graphical methods.		
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate e			
	the operational performance of electric machi	ines from the charactersitic data and theyca	n calculate thereo	f coloctod auantiti
		-		i selected qualitit
	and characteristic curves.			
	and characteristic curves.			
Workload in Hours				
	Independent Study Time 110, Study Time in Le			
Workload in Hours Credit points Course achievement	Independent Study Time 110, Study Time in Le			
Credit points Course achievement	Independent Study Time 110, Study Time in Le 6 None			
Credit points Course achievement Examination	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work	octure 70		
Credit points Course achievement Examination	Independent Study Time 110, Study Time in Le 6 None	octure 70		
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work	of design files		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review	of design files n, 7 semester): Specialisation Energy and Envi	iromental Engineer	ring: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program	of design files n, 7 semester): Specialisation Energy and Envi n, 7 semester): Specialisation Electrical Engine	iromental Engineer eering: Elective Co	ring: Compulsory mpulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program	of design files n, 7 semester): Specialisation Energy and Envi n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engi	iromental Engineer eering: Elective Co ineering: Elective C	ring: Compulsory mpulsory Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Compulsory	of design files n, 7 semester): Specialisation Energy and Envi n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engi am, 7 semester): Specialisation Mechanical	iromental Engineer eering: Elective Co ineering: Elective C Engineering, Foc	ring: Compulsory mpulsory Compulsory us Energy Systen
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German prog	of design files n, 7 semester): Specialisation Energy and Envi n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engi am, 7 semester): Specialisation Mechanical	iromental Engineer eering: Elective Co ineering: Elective C Engineering, Foc	ring: Compulsory mpulsory Compulsory us Energy Systen
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory Compulsory	of design files of design files n, 7 semester): Specialisation Energy and Envi n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engi am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanica	iromental Engineer eering: Elective Co ineering: Elective C Engineering, Foc cal Engineering, F	ring: Compulsory mpulsory Compulsory us Energy System Focus Mechatroni
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core qualification: Elect Energy and Environmental Engineering: Core qualification: Elect	of design files n, 7 semester): Specialisation Energy and Envi n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engi am, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engi ion: Compulsory ive Compulsory ualification: Compulsory , 7 semester): Specialisation Electrical Engine	iromental Engineer eering: Elective Co ineering: Elective Co Engineering, Foc cal Engineering, Foc ineering, Focus Th ering: Elective Con	ring: Compulsory mpulsory Compulsory us Energy Systen Focus Mechatroni neoretical Mechani
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core qualification: Elect Electrical Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science and Engineering: Special Logistics and Mobility: Specialisation Engineering	of design files n, 7 semester): Specialisation Energy and Envin n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engine m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engine n, 7 semester): Specialisation Mechanical Engine ion: Compulsory ive Compulsory ualification: Compulsory , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Electrical Engine methods and the second the se	iromental Engineer eering: Elective Co ineering: Elective Co Engineering, Foc cal Engineering, Foc ineering, Focus Th ering: Elective Con romental Engineeri neering: Elective Co	ring: Compulsory mpulsory Compulsory us Energy Systen Focus Mechatroni reoretical Mechani npulsory ing: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 110, Study Time in Le 6 None Subject theoretical and practical work Design of four machines and actuators, review General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Digital Mechanical Engineering: Core qualification: Elect Electrical Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science and Engineering: Speci	of design files n, 7 semester): Specialisation Energy and Envin n, 7 semester): Specialisation Electrical Engine n, 7 semester): Specialisation Mechanical Engine m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engine n, 7 semester): Specialisation Mechanical Engine ion: Compulsory ive Compulsory ualification: Compulsory , 7 semester): Specialisation Electrical Engine , 7 semester): Specialisation Electrical Engine methods and the second the se	iromental Engineer eering: Elective Co ineering: Elective Co Engineering, Foc cal Engineering, Foc ineering, Focus Th ering: Elective Con romental Engineeri neering: Elective Co	ring: Compulsory mpulsory Compulsory us Energy Syster Focus Mechatroni teoretical Mechani npulsory ing: Compulsory

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

Course L0294: Electrical Mac	Course L0294: Electrical Machines and Actuators	
Тур	Recitation Section (large)	
Hrs/wk	2	
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
Electrotechnical Experiments (L071	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 descriptive models and apply them mathematically. They can derive approximative soluti and judge factors influential on the performance of materials in electrical engineering applications.			
Personal Competence Social Competence	Students can jointly solve subject related pro problem solving course.	blems in groups. They can present their resul	ts effectively within	the framework o
Autonomy	Students are capable to extract relevant info the lecture. They can reflect their acquired typical exam questions. Students are able to		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	m, 7 semester): Specialisation Electrical Engi	neering: Compulsor	у
-	Electrical Engineering: Core qualification: Cor			-
-		n, 7 semester): Specialisation Electrical Engir	eering: Compulsory	,
		cialisation Engineering Sciences: Elective Con		
	Orientierungsstudium: Core gualification: Ele		-	

Course L0714: Electrotechnical 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		
Cycle		
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	
	I	

L0685: Materials in E	
Тур	Lecture
Hrs/wk	
	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Manfred Eich
Language	
Cycle	
Content	The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator.
	Analysis of vibrations in a one-dimensional lattice. Phononic bandgap
	Introduction to quantum mechanics
	Wave function, Schrödinger's equation, observables and measurements.
	Quantum mechanical harmonic oscillator and spectral decomposition.
	Symmetries, conserved quantities, and the labeling of states.
	Angular momentum
	The hydrogen atom
	Waves in periodic potentials
	Reciprocal lattice and reciprocal lattice vectors
	Band gap
	Band diagrams The free electron gas and the density of states
	Fermi-Dirac distribution
	Density of charge carriers in semiconductors
	Conductivity in semiconductors. Engineering conductivity through doping.
	The P-N junction (diode)
	Light emitting diodes
	Electromagnetic waves interacting with materials
	Reflection and refraction
	Photonic band gaps
	Origins of magnetization Hysteresis in ferromagnetic materials
	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

Course L0687: Materials in Electrical Engineering (Problem Solving Course)		
	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Manfred Eich	
Language	DE	
Cycle	SoSe	
Content	 Atom structure and periodic system Atom binding and crystal structure Structure and properties of alloys: diffusion, phase diagrams, phase separation and grain boundaries Material properties: Mechanical, thermal, electrical, dielectric properties Metals Semiconductors Ceramics and glasses Polymers Magnetic materials Electrochemistry Oxidation numbers, electrolysis, batteries, fuel cells 	
Literature	H. Schaumburg: Einführung in die Werkstoffe der Elektrotechnik, Teubner (1993)	

Courses				
Title		Тур	Hrs/wk	СР
Electromagnetics for Engineers I: Time-Independent Fields (L2281)		Lecture	3	5
Electromagnetics for Engineers I: T	ime-Independent Fields (L2282)	Recitation Section (small)	2	1
Module Responsible	Dr. Cheng Yang			
Admission Requirements	None			
Recommended Previous	Basic principles of electrical engineering and adv	anced mathematics		
Knowledge				
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
	Students can explain the fundamental formulas, relations, and methods of the theory of time-independent electromagnetic fields. They can explicate the principal behavior of electrostatic, magnetostatic, and current density fields with regard to respectiv sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simpl fields. The students are aware of applications for the theory of time-independent electromagnetic fields and are able to explicat these.			
SKIIIS	s Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independe electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwel Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields a analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, a electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical application.			
Personal Competence				actical application
	Students are able to work together on subject re-			actical application
Social Competence	during exercise sessions).	lated tasks in small groups. They are able to	present their re	
		ation from provided references and relate thi ans of activities that accompany the lecture, ım. Based on respective feedback, students a tions between their knowledge obtained in t	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during t idjust their individu
Autonomy	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by me lectures and exercises that are related to the exa- learning process. They are able to draw connect	ation from provided references and relate thi ans of activities that accompany the lecture, am. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during t adjust their individe
Autonomy	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by me lectures and exercises that are related to the exa learning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect	ation from provided references and relate thi ans of activities that accompany the lecture, am. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during t adjust their individe
Autonomy Workload in Hours	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by me lectures and exercises that are related to the exa learning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect 6	ation from provided references and relate thi ans of activities that accompany the lecture, am. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during t adjust their individe
Autonomy Workload in Hours Credit points Course achievement	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by me lectures and exercises that are related to the exa learning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect 6	ation from provided references and relate thi ans of activities that accompany the lecture, am. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during f adjust their individ
Autonomy Workload in Hours Credit points Course achievement	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by melectures and exercises that are related to the exalearning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect 6 None Written exam	ation from provided references and relate thi ans of activities that accompany the lecture, am. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during t adjust their individe
Autonomy Workload in Hours Credit points Course achievement Examination	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by melectures and exercises that are related to the exalearning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect 6 None Written exam	ation from provided references and relate thi ans of activities that accompany the lecture, am. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis).	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during t adjust their individe
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by melectures and exercises that are related to the exalearning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect 6 None Written exam	ation from provided references and relate thi ans of activities that accompany the lecture, im. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis). ure 70	s information to such as short or are expected to a	sults effectively (e the lecture. They a al quizzes during f adjust their individ
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	during exercise sessions). Students are capable to gather necessary informable to continually reflect their knowledge by melectures and exercises that are related to the exalearning process. They are able to draw connect lectures (e.g. Electrical Engineering I, Linear Alge Independent Study Time 110, Study Time in Lect 6 None Written exam 120 min	ation from provided references and relate thi ans of activities that accompany the lecture, im. Based on respective feedback, students a tions between their knowledge obtained in t bra, and Analysis). ure 70	s information to such as short or are expected to a	sults effectively (the lecture. They al quizzes during idjust their individ

Course L2281: Electromagne	tics for Engineers I: Time-Independent Fields
Тур	Lecture
Hrs/wk	
CP	5
	Independent Study Time 108, Study Time in Lecture 42
	Dr. Cheng Yang, Prof. Christian Schuster
Language	
Cycle	- Maxwell's Equations in integral and differential notation
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 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 L2282: Electromagnetics for Engineers 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	Dr. Cheng Yang, Prof. Christian Schuster
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0854: Mathe	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	erential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Diff		Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	erential Equations) (L1045)	Recitation Section (large)	1 2	1
Complex Functions (L1038) Complex Functions (L1041)		Lecture Recitation Section (small)	2	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements				
Recommended Previous				
Knowledge				
	After taking part successfully, students have reached the	following learning results		
Professional Competence		101101111g 1041		
Knowledge				
······································	 Students can name the basic concepts in Mathema 	tics IV. They are able to explain ther	n using appropri	ate examples.
	Students can discuss logical connections between	these concepts. They are capable	of illustrating th	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce the 	n.		
Skills	 Students can model problems in Mathematics IV 	with the help of the concepts studie	d in this course	Moreover they are
	capable of solving them by applying established m			,
	 Students are able to discover and verify further log 		ots studied in the	e course.
	 For a given problem, the students can develop a 	nd execute a suitable approach, a	nd are able to c	ritically evaluate the
	results.			
Personal Competence				
Social Competence				
	Students are able to work together in teams. They			
	 In doing so, they can communicate new concepts 		erating partners	. Moreover, they can
	design examples to check and deepen the underst	anding of their peers.		
Autonomy	 Students are capable of checking their understand 	ling of complex concepts on their o	wn. They can sp	ecify open questions
	precisely and know where to get help in solving the	em.		
	Students have developed sufficient persistence to	be able to work for longer period	s in a goal-orien	ted manner on hard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equati	ons 2)		
scale				
Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Electrical Enginee	ring: Compulsor	у
Following Curricula	General Engineering Science (German program, 7 se	emester): Specialisation Mechanica	l Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semest	er): Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engin	eering, Focus Th	neoretical Mechanical
	Engineering: Elective Compulsory			
	Computer Science: Specialisation Computational Mathem	atics: Elective Compulsory		
	Computer Science: Specialisation II. Mathematics and Eng	ineering Science: Elective Compulso	ry	
	Electrical Engineering: Core qualification: Compulsory			
	Engineering Science: Specialisation Electrical Engineering			
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 semeste			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanica	Engineering,	Focus Mechatronics:
	Compulsory	er), Cresislication Machanical Engin	eering Feere Th	a avatical Machanical
	General Engineering Science (English program, 7 semest	er): Specialisation Mechanical Engin	eering, Focus Tr	leoretical Mechanical
	Engineering: Compulsory	xx), Specialization Naval Architecture	Compulson	
	General Engineering Science (English program, 7 semeste Computational Science and Engineering: Specialisation II.			llsony
	Mechanical Engineering: Specialisation Mechatronics: Cor		. Liective comp	lisor y
	Mechanical Engineering: Specialisation Theoretical Mechan		orv	
	Mechanical Engineering: Specialisation Theoretical Mecha		Si y	
	Mechatronics: Core qualification: Compulsory	······		
	Naval Architecture: Core qualification: Compulsory			

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

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

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

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Signals and Systems (L0432)		Lecture	3	4
Signals and Systems (L0433)		Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics 1-3			
knowledge	The modul is an introduction to the theory of signals and s 1-3 is expected. Further experience with spectral transfo		-	
	but not required.			
	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe signals and theory. They are able to apply the fundamental transform can describe and analyse deterministic signals and syste understand the effects in time domain and image domain	nations of continuous-time and disc ems mathematically in both time an	rete-time signals nd image domain	and systems. Th n. In particular, th
	discrete-time signal.			
Skills	The students are able to describe and analyse determinis	-		-
	system theory. They can analyse and design basic sy			
Personal Competence	response, stability, linearity etc They can assess the imp	act of ETT systems on the signal prop	berties in time an	a frequency don
	The students can jointly solve specific problems			
	The students can jointly solve specific problems. The students are able to acquire relevant information	from appropriato litoraturo source	os Thoy can c	ontrol their love
Autonomy	knowledge during the lecture period by solving tutorial pr			Shirion them leve
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination				
	90 min			
scale	30 1111			
	General Engineering Science (German program, 7 semest	er): 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 semeste	r): Specialisation Electrical Engineer	ing: Compulsory	
	General Engineering Science (English program, 7 semeste	r): Specialisation Bioprocess Engine	ering: Compulsor	У
	General Engineering Science (English program, 7 semeste	r): Specialisation Computer Science	Compulsory	
	General Engineering Science (English program, 7 ser Compulsory			
	General Engineering Science (English program, 7 sem Compulsory	ester): Specialisation Mechanical E	ngineering, Foci	us Energy Syste
	General Engineering Science (English program, 7 sem Engineering: Compulsory	ester): Specialisation Mechanical E	ingineering, Foc	us Aircraft Syste
	General Engineering Science (English program, 7 semeste Sciences: Compulsory	r): Specialisation Mechanical Engine	ering, Focus Mat	erials in Enginee
	General Engineering Science (English program, 7 se Compulsory			
	General Engineering Science (English program, 7 semest Engineering: Compulsory	er). Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechan
	General Engineering Science (English program, 7 semeste	r): Specialisation Process Engineerir	ig: Compulsory	
	General Engineering Science (English program, 7 semeste	r): Specialisation Biomedical Engine	ering: Compulsor	У
	Computational Science and Engineering: Core qualification	n: Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Science	e: Elective Compulsory		
		e: Elective Compulsory		
Course L0432: Signals and S		e: Elective Compulsory		

Тур	Lecture	
Hrs/wk		
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	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 function
 - Crosscorrelation 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 S	ystems
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
		T	Have for la	67
Title	nas, and Electromagnetic Compatibility (L1669)	Typ Lecture	Hrs/wk 3	CP 4
-	nas, and Electromagnetic Compatibility (L1877)	Recitation Section (small)	2	2
-	Prof. Christian Schuster		-	-
Admission Requirements	None			
Recommended Previous	Basic principles of physics and electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students can explain the basic principles, relationship	s, and methods for the design of wa	veguides and an	tennas as well as
	Electromagnetic Compatibility. Specific topics are:			
	- Fundamental properties and phenomena of electrical	ircuits		
	- Steady-state sinusoidal analysis of electrical circuits			
	- Fundamental properties and phenomena of electroma	gnetic fields and waves		
	- Steady-state sinusoidal description of electromagnetic			
	- Useful microwave network parameters			
	- Transmission lines and basic results from transmissior	line theory		
	- Plane wave propagation, superposition, reflection and			
	- General theory of waveguides			
	- Most important types of waveguides and their propert	es		
	- Radiation and basic antenna parameters			
	- Most important types of antennas and their properties			
	- Numerical techniques and CAD tools for waveguide ar	d 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 more	lels for characterization and choice of	waveguides and	d antennas. They a
	able to assess and qualify their basic electromagne	tic properties. They can apply resu	Its and strategie	es from the field
	Electromagnetic Compatibilty to the development of ele	ctrical components and systems.		
Personal Competence				
	Students are able to work together on subject related	tacks in small groups. Thoy are able	to procept their	rosults offectively
Social Competence	English (e.g. during small group exercises).	tasks in small groups. They are able	to present their	results effectively
	Linglish (e.g. during small group exercises).			
Autonomy	Students are capable to gather information from sub	ject related, professional publication	s and relate tha	t information to th
	context of the lecture. They are able to make a conne	ction between their knowledge obtair	ed in this lecture	e with the content
	other lectures (e.g. theory of electromagnetic fields, fu	ndamentals of electrical engineering	/ physics). They o	can discuss technic
	problems and physical effects in English.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	45 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Electrical Engine	erina: Elective Co	mpulsory
-	Electrical Engineering: Core qualification: Elective Com			
i onowing curricula	Aircraft Systems Engineering: Specialisation Air Transp	•		
	Aircraft Systems Engineering: Specialisation Air Transp Aircraft Systems Engineering: Specialisation Cabin Syst	, , ,		
	General Engineering Science (English program, 7 seme		ring: Elective Cor	npulsory
	servere (English program, 7 serve			

avT	Lecture
Hrs/wk	
	4
-	Independent Study Time 78, Study Time in Lecture 42
	Prof. Christian Schuster
Language	
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 propagatio
	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
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 an		Lecture	3	4	
Introduction to Communications an		Recitation Section (large)	1	1	
ntroduction to Communications an		Recitation Section (small)	1	1	
Module Responsible					
Admission Requirements					
Recommended Previous	 Mathematics 1-3 				
Knowledge	 Signals and Systems 				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results			
Professional Competence					
Knowledge	The students know and understand the fundamental building blocks of a communications system. They can describe a		describe and anal		
	the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are				
	aware of the essential resources and evalu	uation criteria of information transmission and are	able to design a	and evaluate a ba	
	communications system.				
Skills	The students are able to design and eva	luate a basic communications system. In particu	llar, they can e	stimate the requi	
	resources in terms of bandwidth and powe	er. They are able to assess essential evaluation pa	rameters of a ba	asic communication	
	system such as bandwidth efficiency or bit	error rate and to decide for a suitable transmission	method.		
Personal Competence					
Social Competence	The students can jointly solve specific prob	olems.			
Autonomy		nt information from appropriate literature sourc	-	ontrol their level	
	knowledge during the lecture period by solv	ving tutorial problems, software tools, clicker system	m.		
Workload in Hours	Independent Study Time 110, Study Time in	n Lecture 70			
Credit points	6				
	None				
	4				
Course achievement	Written exam				
Course achievement Examination					
Course achievement Examination	90 min				
Course achievement Examination Examination duration and scale	I 90 min	ram, 7 semester): Specialisation Electrical Enginee	ring: Compulsor	/	
Course achievement Examination Examination duration and scale	90 min General Engineering Science (German prog	ram, 7 semester): Specialisation Electrical Enginee r and Software Engineering: Elective Compulsory	ring: Compulsory	/	
Course achievement Examination Examination duration and scale Assignment for the	90 min General Engineering Science (German prog	r and Software Engineering: Elective Compulsory	ring: Compulsory	/	
Course achievement Examination Examination duration and scale Assignment for the	90 min General Engineering Science (German prog Computer Science: Specialisation Compute	r and Software Engineering: Elective Compulsory tional Mathematics: Elective Compulsory	ring: Compulsory	/	
Course achievement Examination Examination duration and scale Assignment for the	90 min General Engineering Science (German prog Computer Science: Specialisation Compute Computer Science: Specialisation Computa	r and Software Engineering: Elective Compulsory tional Mathematics: Elective Compulsory ompulsory	ring: Compulsory	/	
Course achievement Examination Examination duration and scale Assignment for the	90 min General Engineering Science (German prog Computer Science: Specialisation Compute Computer Science: Specialisation Computa Data Science: Core qualification: Elective C Electrical Engineering: Core qualification: C	r and Software Engineering: Elective Compulsory tional Mathematics: Elective Compulsory ompulsory ompulsory		/	
Course achievement Examination Examination duration and scale Assignment for the	90 min General Engineering Science (German prog Computer Science: Specialisation Compute Computer Science: Specialisation Computa Data Science: Core qualification: Elective C Electrical Engineering: Core qualification: C	r and Software Engineering: Elective Compulsory tional Mathematics: Elective Compulsory ompulsory compulsory ram, 7 semester): Specialisation Electrical Engineer		/	

Course L0442: Introduction t	to Communications and Random Processes
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	
Language	
Cycle Content	
content	Fundamentals of random processesIntroduction 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

Courses				
Title		Тур	Hrs/wk	СР
-	tion to Electrical Power Systems (L1670)	Lecture	3	4
	tion to Electrical Power Systems (L1671)	Recitation Section (small)	2	2
Module Responsible				
Admission Requirements	None			
	Fundamentals of Electrical Engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	Knowledge Students are able to give an overview of conventional and modern electric power systems. They can explain			
	evaluate technologies of electric power generatio	n, transmission, storage, and distribution a	s well as integrati	on of equipment in
	electric power systems.			
Skills	With completion of this module the students a	re able to apply the acquired skills in ar	plications of the	design, integratio
	development of electric power systems and to as			
Personal Competence				
Social Competence	The students can participate in specialized and in	terdisciplinary discussions, advance ideas a	nd represent the	ir own work results
	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 Lectu	100 70		
		ile 70		
Credit points Course achievement	None			
Examination	Written exam			
Examination duration and	90 - 150 minutes			
scale				
Assignment for the	General Engineering Science (German program, 7		-	
Following Curricula	General Engineering Science (German program, 7 Compulsory	semester): specialisation Green Technolog	lies, Focus Renew	able Energy: Electr
	Data Science: Core qualification: Elective Compute			
	Electrical Engineering: Core qualification: Elective	•		
	Energy and Environmental Engineering: Specialisa		orv	
	Energy Systems: Specialisation Energy Systems: I			
	General Engineering Science (English program, 7		rina: Elective Cor	mpulsory
	Green Technologies: Energy, Water, Climate: Spe		-	
	Computational Science and Engineering: Specialis		-	llsory
	Renewable Energies: Core qualification: Compulso			
	Theoretical Mechanical Engineering: Technical Co	•		
	Theoretical Mechanical Engineering: Specialisation			

ourse L1670: Electrical Pow	er Systems I: Introduction to Electrical Power Systems
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
	Innes
	transformers
	 synchronous machines induction machines
	 loads and compensation mid structures and substations
	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						
				True	line (ur)-	CD
Title				Typ Practical Course	Hrs/wk 2	CP 2
EE Experimental Lab (L0781) Measurements: Methods and Data	Processing (10779)			Lecture	2	2
Measurements: Methods and Data	-			Recitation Section (small)	1	1
Module Responsible	-	aefer				
Admission Requirements	None					
Recommended Previous	principles of mathem	natics				
Knowledge	· ·					
Educational Objectives	After taking part and	eeefully, students	a barra waa abad tha fallow	ing loopping you lto		
Educational Objectives	Alter taking part succ	cessiuny, students	s have reached the follow	ing learning results		
Professional Competence	The shudents are abl			dates a successive succession and successive		
Knowledge				d the acquisition and proce	-	-
			s, and explain the proces	ssing of stochastic signals.	Students know metr	lods to digitalize a
	describe measured si	signals.				
Skills	The students are able	e to evaluate prob	plems of metrology and to	o apply methods for descril	bing and processing	of measurements.
Personal Competence						
Social Competence	The students solve pr	roblems in small g	groups.			
Autonomy	The students can ref	lect their knowled	ge and discuss and evalu	late their results		
Autonomy	The students current		ge and discuss and evalu			
Workload in Hours	Independent Study T	ime 110. Study Ti	me in Lecture 70			
Credit points						
Course achievement		Form	Description			
	Yes 10 %	Excercises				
Examination	Written exam					
Examination duration and	90 min					
scale						
	General Engineering	Science (German	program 7 semester). S	pecialisation Electrical Eng	ineering: Elective Co	mpulsory
Assignment for the						
Assignment for the Following Curricula	Electrical Engineering					
5	Electrical Engineering	g: Core qualification	on: Compulsory	ecialisation Electrical Engli	neering: Elective Cor	npulsory

Course L0781: EE Experimen	Course L0781: EE Experimental Lab		
Тур	Practical Course		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Alexander Schlaefer, Prof. Rolf-Rainer Grigat, Prof. Herbert Werner, Dozenten des SD E, Prof. Christian Becker, Prof. Heiko		
	Falk, Prof. Thorsten Kern, Prof. Alexander Kölpin		
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	ourse L0779: Measurements: Methods and Data Processing				
Тур	Lecture				
Hrs/wk	2				
CP	3				
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28				
Lecturer	Prof. Alexander Schlaefer				
Language	DE				
Cycle	WiSe				
Content	introduction, systems and errors in metrology, probability theory, measuring stochastic signals, describing measurements, acquisition of analog signals, applied metrology				
Literature	Puente León, Kiencke: Messtechnik, Springer 2012				
	Lerch: Elektrische Messtechnik, Springer 2012 Weitere Literatur wird in der Veranstaltung bekanntgegeben.				

Course L0780: Measurement	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		

Courses						
Title			Тур	Hrs/wk	СР	
Electronic Devices (L0720) Electronic Devices (L0721)			Lecture Project-/problem-l	3 based Learning 2	4 2	
Module Responsible	Prof. Hoc Khiem Trieu					
Admission Requirements	None					
Recommended Previous	Atomic model and quantum	n theory, electrical o	urrents in solid state materials, bas	sics in solid-state physics		
Knowledge	Successful participation of F	Physics for Enginee	rs and Materials in Electrical Engine	ering or courses with equiva	alent contents	
Educational Objectives	After taking part successful	lly, students have re	eached the following learning result	S		
Professional Competence						
Knowledge						
	Students are able					
	 to represent the basi 	ics of semiconducto	r physics,			
	 to explain the operat 	ting principle of imp	ortant semiconductor devices,			
	 to outline device cha 	racteristics and equ	ivalent circuits as well as to explain	n their derivation and		
	• to outline device characteristics and equivalent circuits as well as to explain their derivation and					
	 to discuss the limitat 	tion of device mode	S.			
Skills						
on mo						
	Students are capable					
	 to apply devices in b 	asic circuits,				
	 to realize the physical 	al context and to so	lve complex problems by oneself			
Personal Competence						
	Students are able to prepar	re and perform thei	r lab experiments in team work as	well as to present and discu	ss the results in fro	
,	of audience.					
Autonomy	Students are capable to acc	quire knowledge ba	sed on literature in order to prepare	e their experiments.		
Workload in Hours	Independent Study Time 11	L0, Study Time in Le	ecture 70	·		
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
		ject theoretical	andStudierenden erarbeiten in Kle			
	prac	ctical work	demonstrieren dieses in F Diskussion. Darüber hinaus			
			inhaltlich zu dem jeweiligen Ve		obungsdurgube, v	
Examination	Written exam		, ,	5		
Examination duration and	120 min					
scale						
			n, 7 semester): Specialisation Electr	ical Engineering: Compulso	У	
Following Curricula	Electrical Engineering: Core					
	Engineering Science: Specia		ingineering: Compulsory , 7 semester): Specialisation Electri	cal Engineering, Compulser	,	
			alisation II. Mathematics & Enginee			

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				
Fitle	т	a	Hrs/wk	СР
ntroduction to Control Systems (L(cture	2	4
ntroduction to Control Systems (L0	0655) Re	citation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and frequency doma	in, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	 Students can represent dynamic system behavior in time an 	d frequency domain and	can in particular	explain properties
	first and second order systems			
	They can explain the dynamics of simple control loops and ir	terpret dynamic propertie	s in terms of free	quency response a
	root locus			
	They can explain the Nyquist stability criterion and the stabil			
	They can explain the role of the phase margin in analysis and			
	They can explain the way a PID controller affects a control log They can explain issues arising when controllers designed in			digitally
	They can explain issues arising when controllers designed in	continuous time domain a	re implemented	uigitally
Skills	Students can transform models of linear dynamic systems fro	om time to frequency dom	ain and vice vers	a
	 They can simulate and assess the behavior of systems and co 			ŭ
	They can design PID controllers with the help of heuristic (Zie			
	They can analyze and synthesize simple control loops with th	e help of root locus and fr	equency respons	e techniques
	They can calculate discrete-time approximations of con	trollers designed in cont	tinuous-time and	d use it for digi
	implementation			
	 They can use standard software tools (Matlab Control Toolbo) 	x, Simulink) for carrying ou	ut these tasks	
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problem	s, and experimentally vali	date their contro	ller designs
Autonomy	Students can obtain information from provided sources (lecture r	otes, software documenta	ation, experimen	t guides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-line tests and thereb	y control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and thereb	y control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and thereb	y control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and thereb	y control their learning pro	ogress.	
		y control their learning pro	ogress.	
	Independent Study Time 124, Study Time in Lecture 56	y control their learning pro	ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56 6	y control their learning pro	ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 56 6 None	y control their learning pro	ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	y control their learning pro	ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	y control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of		ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory	qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of	qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elec	qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory	qualification: Compulsory tive Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory	qualification: Compulsory tive Compulsory ory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory tive Compulsory ory lisation Electrical Engineer lisation Civil Engineering:	ring: Compulsory Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compuls General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory tive Compulsory ory lisation Electrical Engineer lisation Civil Engineering: f lisation Bioprocess Engine	ring: Compulsory Compulsory ering: Compulsor	у
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energi Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory tive Compulsory lisation Electrical Engineer lisation Civil Engineering: lisation Bioprocess Engine lisation Energy and Enviro lisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory	y ing: Compulsory
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsor General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia Sciences: Compulsory General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory tive Compulsory lisation Electrical Engineer lisation Electrical Engineer lisation Bioprocess Engine lisation Bioprocess Engine lisation Energy and Enviro lisation Computer Science Specialisation Mechanical E decialisation Mechanical Engine Specialisation Mechanical Engine Specialisation Mechanical Engine	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, Foc Engineering, Foc eering, Focus Mat I Engineering, F neering, Focus P	y ing: Compulsory ocus Biomechanie us Energy Systen us Aircraft Syster erials in Engineeri Focus Mechatronie roduct Developme
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsor General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia Sciences: Compulsory General Engineering Science (English program, 7 semester): Specia and Production: Compulsory General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory tive Compulsory lisation Electrical Engineer lisation Electrical Engineer lisation Bioprocess Engine lisation Bioprocess Engine lisation Energy and Enviro lisation Computer Science Specialisation Mechanical E decialisation Mechanical Engine Specialisation Mechanical Engine Specialisation Mechanical Engine	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, Foc Engineering, Foc eering, Focus Mat I Engineering, F neering, Focus P	y ing: Compulsory ocus Biomechanie us Energy Systen us Aircraft Syster erials in Engineeri Focus Mechatronie roduct Developme
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsor General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia Sciences: Compulsory General Engineering Science (English program, 7 semester): Specia and Production: Compulsory General Engineering Science (English program, 7 semester): Specia Engineering: Compulsory	qualification: Compulsory tive Compulsory lisation Electrical Engineer lisation Civil Engineering: 1 lisation Bioprocess Engine lisation Computer Science Specialisation Mechanical E pecialisation Mechanical Engine Specialisation Mechanical Engine Specialisation Mechanical Engine alisation Mechanical Engine	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, Foc Engineering, Foc earing, Focus Mat I Engineering, F neering, Focus P eering, Focus Th	y ing: Compulsory ocus Biomechanio us Energy System us Aircraft Syster erials in Engineeri Focus Mechatronio roduct Developme
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsor General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia Sciences: Compulsory General Engineering Science (English program, 7 semester): Specia and Production: Compulsory General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory tive Compulsory lisation Electrical Engineer lisation Civil Engineering: 1 lisation Bioprocess Engine lisation Energy and Enviro lisation Computer Science Specialisation Mechanical E ecialisation Mechanical Engine Specialisation Mechanical Engine specialisation Mechanical Engine alisation Mechanical Engine alisation Mechanical Engine	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, Foc Engineering, Foc eering, Focus Mat I Engineering, Focus neering, Focus P eering, Focus Th eering, Focus Th eering, Focus Th	y ing: Compulsory ocus Biomechanio us Energy System us Aircraft Syster erials in Engineeri Focus Mechatronio roduct 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 plots
	Root locus design of PID controllers
	Frequency response techniques
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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 equationsTustin 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	urse L0655: Introduction to Control Systems			
Тур	citation Section (small)			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Herbert Werner			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Courses				
Title		Тур	Hrs/wk	СР
Electromagnetics for Engineers II: Time-Dependent Fields (L2283)		Lecture	3	5
Electromagnetics for Engineers II: 1	ime-Dependent Fields (L2284)	Recitation Section (small)	2	1
Module Responsible	Dr. Cheng Yang			
Admission Requirements	None			
Recommended Previous	Electrical Engineering I, Electrical Engineering II, Th	eoretical Electrical Engineering I		
Knowledge	Mathematics I, Mathematics II, Mathematics III, Mat	hematics IV		
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	Students are able to explain fundamental for electromagnetic fields. They can assess the princip regard to respective sources. They can describe t solutions for simple fields. The students are aware able to explicate these.	al behavior and characteristics of quasistance properties of complex electromagnetic	ationary and fully c fields by means	dynamic fields wi s of superposition
Skills	Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time dependent field problems. They can assess the principal effects of given time-dependent sources of fields and analyze thes quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, ski depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications.			
Personal Competence				
Social Competence	Students are able to work together on subject relat during exercise sessions).	ed tasks in small groups. They are able to	present their re	sults effectively (e.
Autonomy	Students are capable to gather necessary informati able to continually reflect their knowledge by mean lectures and exercises that are related to the exam learning process. They are able to draw conne University of Technology (TUHH), e.g. in the area of	s of activities that accompany the lecture, Based on respective feedback, students ctions between acquired knowledge and	such as short or are expected to a	al quizzes during t djust their individu
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Engineering Science: Specialisation Electrical Engin	eering: Compulsory		
Following Curricula	Engineering Science: Specialisation Mechatronics: 0	Compulsory		
	General Engineering Science (English program, 7 se	emester): Specialisation Electrical Engineer	ring: Compulsory	
	General Engineering Science (English program, 7 se	mester): Specialisation Mechatronics: Con	nnulsory	

Тур	Lecture
Hrs/wk	3
СР	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Dr. Cheng Yang, Prof. Christian Schuster
Language	
-	WiSe
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 u 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 L2284: Electromagnetics for Engineers II: Time-Dependent Fields				
Тур	Recitation Section (small)			
Hrs/wk	2			
СР	1			
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28			
Lecturer	Dr. Cheng Yang, Prof. Christian Schuster			
Language	EN			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Courses					
Title		Тур	Hrs/wk	СР	
Semiconductor Circuit Design (L07)	33)	Lecture	3	4	
Semiconductor Circuit Design (L08	54)	Recitation Section (small)	1	2	
Module Responsible	Prof. Matthias Kuhl				
Admission Requirements	None				
Recommended Previous	Fundamentals of electrical engineering				
Knowledge	Racics of physics, ospecially somiconductor physics				
	Basics of physics, especially semiconductor physics				
Educational Objectives	After taking part successfully, students have reached th	e following learning results			
Professional Competence Knowledge					
	 Students have knowledge about memory circuits Students know the appropriate fields for the use 		d specifications.		
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 heterogeneo Students working together in small groups can so 		questions.		
Autonomy	Students are able to assess their level of knowled	lge.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Course achievement					
Examination					
Examination duration and					
scale	120 1111				
	General Engineering Science (German program, 7 seme	ster): Specialisation Electrical Engine	ering: Compulsory		
	General Engineering Science (German program, 7			ocus Mechatron	
. energie	Compulsory		in Engineering, it		
	Data Science: Core qualification: Elective Compulsory				
	Electrical Engineering: Core qualification: Compulsory				
	Engineering Science: Specialisation Electrical Engineering	ng: Compulsory			
	Engineering Science: Specialisation Mechatronics: Comp	bulsory			
General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mec				
Compulsory					
	General Engineering Science (English program, 7 semes	ter): Specialisation Mechatronics: Con	npulsory		
Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory					
Mechanical Engineering: Specialisation Mechatronics: Compulsory					
	Mechatronics: Core qualification: Compulsory				
	Technomathematics: Specialisation III. Engineering Scie	nce: Elective Compulsory			

Course L0763: Semiconducto	or Circuit Design
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	SoSe
Content	 Repetition Semiconductorphysics and Diodes Functionality and characteristic curve of bipolar transistors Basic circuits with bipolar transistors Functionality and characteristic curve of MOS transistors Basic circuits with MOS transistors for amplifiers Operational amplifiers and their applications Typical applications for analog and digital circuits Realization of logical functions Basic circuits with MOS transistors for combinational logic Memory circuits Basic circuits with MOS transistors for sequential logic Basic concepts of analog-to-digital and digital-to-analog-converters
Literature	 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Course L0864: Semiconducto	or Circuit Design			
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	of. Matthias Kuhl, Weitere Mitarbeiter			
Language	DE			
Cycle	SoSe			
Content	 Basic circuits and characteristic curves of bipolar transistors Basic circuits and characteristic curves of MOS transistors for amplifiers Realization and dimensioning of operational amplifiers Realization of logic functions Basic circuits with MOS transistors for combinational and sequential logic Memory circuits Circuits for analog-to-digital and digital-to-analog converters Design of exemplary circuits 			
Literature	U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo			

Module M0734: Electi	rical Engineering Project Laboratory
Courses	
Title	Typ Hrs/wk CP
Electrical Engineering Project Labo	ratory (L0640) Project-/problem-based Learning 8 6
Module Responsible	Prof. Christian Becker
Admission Requirements	
	Electrical Engineering I, Electrical Engineering II
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to give a summary of the technical details of projects in the area of electrical engineering and illustrate
	respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate
	technical language. They can explain the typical process of solving practical problems and present related results.
<i>ci ''</i>	
Skills	The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems.
	They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students ar able to develop, compare, and choose conceptual solutions for non-standardized problems.
Personal Competence	
Social Competence	Students are able to cooperate in small, mixed-subject groups in order to independently derive solutions to given problems in the
	context of electrical engineering. They are able to effectively present and explain their results alone or in groups in front of a
	qualified audience. Students have the ability to develop alternative approaches to an electrical engineering problem
	independently or in groups and discuss advantages as well as drawbacks.
Autonomy	Students are capable of independently solving electrical engineering problems using provided literature. They are able to fill gaps
Autonomy	in as well as extent their knowledge using the literature and other sources provided by the supervisor. Furthermore, they can
	meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts.
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
	based on task + presentation
scale	Consul Engineering Colonge (Correspondent Zeomeskon), One delivering Electrical Engineering Consulta
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core qualification: Compulsory
i onowing curricula	Engineering Science: Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Course L0640: Electrical Eng	ineering Project Laboratory
Тур	Project-/problem-based Learning

- 76	rioject prosteri basea zearning				
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).				

Courses	
	The Hardwide CD
Fitle Management Tutorial (L0882)	TypHrs/wkCPRecitation Section (small)23
ntroduction to Management (L088	
Module Responsible	Prof. Christoph Ihl
Admission Requirements	None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planni and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	 explain the differences between Economics and Management and the sub-disciplines in Management and to nai important definitions from the field of Management
	• explain the most important aspects of and goals in Management and name the most important aspects of entreprneu
	projects
	describe and explain basic business functions as production, procurement and sourcing, supply chain manageme
	organization and human ressource management, information management, innovation management and marketing
	 explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives a uncertainty, and explain some basic methods from mathematical Finance
	 state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to ca out an Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately
	analyse organisational and staff structures of companies
	 apply methods for decision making under multiple objectives, under uncertainty and under risk
	 analyse production and procurement systems and Business information systems
	 analyse and apply basic methods of marketing
	 select and apply basic methods from mathematical finance to predefined problems
	 apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
	work successfully in a team of students
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	 to communicate appropriately and
	 to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	 work in a team and to organize the team themselves
	to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and	several written exams during the semester
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 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 Biomechan Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 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 Biomechan Compulsory
	Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Einergy and Environmental Engineering General Engineering Science (English program, 7 semester): Specialisation Einergy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste

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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 s 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.

[173]

ELO880: Introduction t				
Typ Hrs/wk	2 Lecture			
-	3			
	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneli			
	erstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona			
5 5	DE			
	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, Innova			
	Management, Marketing and Sales			
	Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informa			
	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 			
	 Selected Planning Tasks, e.g. Investment and Plancial 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. A Stuttgart 2005.			
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.			
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.			

Specialization Energy and Enviromental Engineering

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

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

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science responds to two developments: on the one hand the increasing significance of environmental protection through CO_2 separation in large power stations and, on the other, the growing supply of electricity from regenerative energy sources. Both these key developments in electricity generation are taken into consideration in designing the degree course. Not only for the CO_2 separation technologies but also for other environmental protection purposes, as for example air pollution protection, key qualifications in Chemistry play an important role. Conventional and renewable electricity generation technologies are covered in the degree more detailed but still under a generalist viewpoint.

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

Module M0933: Funda	amentals of Materials Science					
Courses						
Title		Тур	Hrs/wk	СР		
IITIE Fundamentals of Materials Science I (L1085)		Lecture	2	2		
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)		Lecture	2	2		
	Physical and Chemical Basics of Materials Science (L1095)		2	2		
Module Responsible	Prof. Jörg Weißmüller					
Admission Requirements	None					
Recommended Previous	Highschool-level physics, chemistry und mathematics					
Knowledge						
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results				
Professional Competence						
-	The students have acquired a fundamental knowledge on r	metals, ceramics and	d polymers and can descr	ibe this knowledge		
	comprehensively. Fundamental knowledge here means specific					
	phase transformations, corrosion and mechanical properties. T					
	for materials and can identify relevant approaches for cha	aracterizing specific	properties. They are able	to trace materials		
	phenomena back to the underlying physical and chemical laws	of nature.				
Skills	The students are able to trace materials phenomena back t					
	phenomena here refers to mechanical properties such as stre					
	resistance, and to phase transformations such as solidificatio					
		between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the				
	material's behavior.					
Personal Competence						
Social Competence	-					
Autonomy						
	Independent Study Time 96, Study Time in Lecture 84					
Credit points						
Course achievement						
Examination						
Examination duration and	180 min					
scale						
Assignment for the	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			ng: Compulsory		
	General Engineering Science (German program, 7 semester): S					
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Al	contecture: compulsory			
	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		nd Enviromental Engineerir	a: Compulsory		
	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			3		
	Contract Engineering Science (Enginish program), 7 Science (1) Specialisation Havan Architecture, Comparisony					

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

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Course L1085: Fundamentals of Materials Science I	
Тур	Lecture
Hrs/wk	2
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	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 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			Tun		Hrs/wk	СР
Embodiment Design and 3D-CAD (I	0268)		Typ Lecture		Hrs/wk 2	1
Mechanical Design Project I (L0695)			Project-/problem-	-based Learning	3	2
Mechanical Design Project II (L0592)			Project-/problem-		3	2
Team Project Design Methodology	(L0267)		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 	ngineering				
Educational Objectives	After taking part suc	ccessfully, students have re	ached the following learning result	ts		
Professional Competence						
Knowledge	After passing the me	odule, students are able to:				
			parts e.g. considering load situation	on, materials and	d manufactur	ing requirements
	describe basi ovplain basis		ocianina			
	explain basics	s methods of engineering d	esigning.			
Skills	After passing the me	odule, students are able to:				
	• independent	v craata skatshas, tashnisa	I drawings and documentations o			
		onents based on design gui	I drawings and documentations e.	g. using 5D CAD	',	
		alculate) used components,				
			ering design tasks systamtically a	nd solution-orier	nted	
		ty techniques in teams.		a solution oner	iccu,	
	- apply creative	ty teeninques in teams.				
Personal Competence						
Social Competence	After passing the module, students are able to:					
	 develop and r 	evaluate solutions in group	including making and documenti	na decisions		
		use of scientific methods,	including making and documents	ng accisions,		
			cal drawings within groups,			
		n results in the work group				
Autonomy	Students are able					
	 to estimate t 	heir level of knowledge usi	ng activating methods within the	lectures (e.g. wi	th clickers),	
	 To solve engi 	neering design tasks syster	natically.			
Workload in Hours	Indonondont Study	Time 40. Study Time in Les	turo 140			
Credit points		Time 40, Study Time in Lec	luie 140			
Course achievement		Form	Description			
course demoternent	Yes None	Written elaboration	Teamprojekt Konstruktionsme	thodik		
	Yes None	Written elaboration	Konstruktionsprojekt 1			
	Yes None	Written elaboration	Konstruktionsprojekt 2			
	Yes None	Written elaboration	3D-CAD-Praktikum			
Examination	Written exam					
Examination duration and	180				· · · ·	
scale						
Assignment for the	General Engineering	Science (German program	, 7 semester): Specialisation Mech	anical Engineer	ing: Compuls	ory
Following Curricula	General Engineering	Science (German program	, 7 semester): Specialisation Biom	edical Engineeri	ing: Compuls	ory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory					
	Digital Mechanical E	ngineering: Core qualificat	on: Compulsory			
	Energy and Environ	mental Engineering: Core q	ualification: Compulsory			
	General Engineering	Science (English program,	7 semester): Specialisation Energ	y and Envirome	ntal Engineer	ing: Compulsory
	General Engineering	Science (English program,	7 semester): Specialisation Mecha	anical Engineerir	ng: Compulso	ory
	General Engineering	Science (English program,	7 semester): Specialisation Biome	edical Engineerir	ng: Compulso	ry
	-	ring: Core qualification: Cor	npulsory			
	Mechatronics: Core	qualification: Compulsory				
	Neval Arebitesture.	Core qualification: Compuls				

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

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

Courses				
Fitle	<u> </u>	Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	d the following learning results		
Professional Competence				
Knowledge	This module deals with the foundations of the fund programming down to gates. The module includes the		s the layers from	t the assembly-h
	Introduction			
	 Combinational logic: Gates, Boolean algebra, Sequential logic: Flip-flops, automata, system 		mbinational net	works
	Technological foundations	auc nardware design		
	Computer arithmetic: Integer addition, subtra	ction, multiplication and division		
	Basics of computer architecture: Programmin		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM,	caches		
	Input/output: I/O from the perspective of the 0	CPU, principles of passing data, point-to-p	oint connections,	busses
Skills	The students perceive computer systems from the a	rchitect's perspective i.e. they identify t	he internal struct	ure and the phys
<i>U</i> (<i>m</i>)	composition of computer systems. The students can			
	collection of few and simple components. They are	able to distinguish between and to expla	ain the different	abstraction layer
	today's computing systems - from gates and circuits	up to complete processors.		
	After successful completion of the module, the stu	dents are able to judge the interdepend	encies between	a physical comp
	system and the software executed on it. In particula			
	on the hardware-centric abstraction layers from the			
	the impact that these low abstraction levels have on	an entire system's performance and to p	ropose feasible c	ptions.
Personal Competence				
	Students are able to solve similar problems alone or	in a group and to present the results acco	ordingly.	
Autonomy	Students are able to acquire new knowledge from sp	pecific literature and to associate this know	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points		escription		
Course achievement	Yes 10 % Excercises	escription		
Examination	Written exam			
Examination duration and	90 minutes, contents of course and labs			
scale				
Assignment for the	General Engineering Science (German program, 7 se	emester): Specialisation Computer Science	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7 se			iry
	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se		5 1 5	/
	General Engineering Science (German program, 7 se	entester). Specialisation biomedical chuin		NFL /
	General Engineering Science (German program, 7 se			
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	emester): Specialisation Energy and Enviro	omental Engineer	
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se General Engineering Science (German program,	emester): Specialisation Energy and Enviro emester): Specialisation Process Engineeri	omental Engineer ng: Compulsory	ring: Compulsory
	General Engineering Science (German program, 7 se	emester): Specialisation Energy and Enviro emester): Specialisation Process Engineeri	omental Engineer ng: Compulsory	ring: Compulsory
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Course L0321: Computer Engineering		
Тур	Lecture	
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 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
Electrical Machines and Actuators Electrical Machines and Actuators		Lecture Recitation Section (large)	3	4
Module Responsible		Rectation Section (large)	2	2
Admission Requirements	None			
Recommended Previous		o numbors intograls differentials		
Knowledge				
Knowledge	Basics of electrical engineering and mechanical engineering			
Educational Obiectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
-	e Students can to draw and explain the basic principles of electric and magnetic fields.			
	They can describe the function of the st	andard types of electric machines and p	present the correspon	nding equations a
	characteristic curves. For typically used drive	s they can explain the major parameters of	the energy efficiency	of the whole syste
	from the power grid to the driven engine.			
Skills	Students arw able to calculate two-dimension		ar ferromagnetic circu	uits with air gap. F
	this they apply the usual methods of the des	gn auf electric machines.		
	They can calulate the operational performa	nce of electric machines from their given c	haracteristic data and	d selected quantiti
	and characteristic curves. They apply the use	al equivalent circuits and graphical method	ls.	
Personal Competence				
Social Competence	none			
Autonomy	Students are able independently to calculate			
	the operational performance of electric mad	hines from the charactersitic data and the	ycan calculate thereo	of selected quantiti
	and characteristic curves.			
Workload in Hours				
	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	Independent Study Time 110, Study Time in 6	Lecture 70		
Credit points Course achievement	6	Lecture 70		
Course achievement	6 None	Lecture 70		
Course achievement Examination	6 None Subject theoretical and practical work			
Course achievement Examination	6 None			
Course achievement Examination Examination duration and scale	6 None Subject theoretical and practical work	w of design files	Enviromental Enginee	ring: Compulsory
Course achievement Examination Examination duration and scale Assignment for the	6 None Subject theoretical and practical work Design of four machines and actuators, revie	w of design files m, 7 semester): Specialisation Energy and l	-	
Course achievement Examination Examination duration and scale Assignment for the	6 None Subject theoretical and practical work Design of four machines and actuators, revie General Engineering Science (German progra	w of design files m, 7 semester): Specialisation Energy and l m, 7 semester): Specialisation Electrical En	gineering: Elective Co	mpulsory
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Course L0293: Electrical Mac	hines and Actuators
Тур	Lecture
Hrs/wk	3
CP	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 Fundamentals of Fluid Mechanics (_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	Mathematics I+II+III			
Knowledge	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	Simplification and solving of partial different	tial equations		
	Integration			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	Students are able to:			
	 explain the difference between different typ give an overview for different applications of 			
	 explain simplifications of the Continuity- and 			ions
			Soundary contait	
Skills	The students are able to			
	 describe and model incompressible flows m 	athematically		
	 reduce the governing equations of fluid med 	chanics by simplifications to archive quanti	tative solutions e	.g. by integration
	 notice the dependency between theory and 	technical applications		
	use the learned basics for fluid dynamical a	pplications in fields of process engineering		
Personal Competence				
Social Competence	The students			
	• are capable to gather information from sub	iest related professional publications and	rolato that inform	nation to the cont
	 are capable to gather information from sub of the lecture and 	ject related, professional publications and		
	 able to work together on subject related ta 	isks in small groups. They are able to pres	ent their results	effectively in Engl
	(e.g. during small group exercises)			
	are able to work out solutions for exercises	by themselves, to discuss the solutions ora	Illy and to presen	t the results.
Autonomy	The students are able to			
	 search further literature for each topic and t work on their exercises by their own and to 			
	• work on their exercises by their own and to	evaluate their actual knowledge with the h	eeuback.	
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Course achievement		Description		
Examination	Yes 5 % Midterm Written exam			
Examination duration and				
scale	5 110015			
	General Engineering Science (German program, 7	semester): Specialisation Process Engineer	rina: Compulsory	
-	General Engineering Science (German program, 7			ory
2	General Engineering Science (German program, 7			
	Bioprocess Engineering: Core qualification: Compu	ilsory		
	Energy and Environmental Engineering: Core quali	ification: Compulsory		
	General Engineering Science (English program, 7 s	semester): Specialisation Bioprocess Engine	eering: Compulso	ry
	General Engineering Science (English program, 7 s	semester): Specialisation Energy and Enviro	omental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 s		ng: Compulsory	
	Technomathematics: Specialisation III. Engineering			
	Process Engineering: Core qualification: Compulso	ry		

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	 fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course L0092: Fluid Mechani	ics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

	wables and Energy Systems			
Courses				
Fitle		Тур	Hrs/wk	СР
Power Industry (L0316)		Lecture	1	1
Energy Systems and Energy Indust	ry (L0315)	Lecture	2	2
Renewable Energy (L0313)		Lecture	2	2
Renewable Energy (L1434)		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	With completion of this module, the students can provide an overview of characteristics of energy systems and their econor efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, pow distribution and power trading wih regard to subject-related contexts. The students can explain these aspects, which a applicable to many energy systems in general, especially for renewable energy systems and critical discuss them. Furthermore the students can explain the environmental benefits from the use of such systems.			
Skills	Students are able to apply methodologies for detailed determination of energy demand or energy production for various typ energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design i 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 of		ally and design th rules, also for	
Development Commentering	and to put them them into the right context	<u>.</u>		
Personal Competence	The shudents are able to evolve a situate			
Social Competence		technical alternatives and to assess them wit lows them to make an effective contribuition to		
Autonomy	Students can independently exploit source	es , acquire the particular knowledge about the	e subject area and	I transform it to r
	questions.		-	
	Independent Study Time 96, Study Time 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 prog	ram, 7 semester): Specialisation Energy and En	viromental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German prog	ram, 7 semester): Specialisation Process Engine	erina: Compulsorv	
3		ogram, 7 semester): Specialisation Mechanica		us Energy Syste
	Elective Compulsory		5 5,	
		ogram, 7 semester): Specialisation Mechanica	l Engineering For	us Energy Syste
		Jyram, / semester). Specialisation Mechanica	in Engineering, FOC	us Linergy Syste
	Compulsory			
	Civil- and Environmental Engineering: Speci	ialisation Civil Engineering: Elective Compulsory		
	Civil- and Environmental Engineering: Speci	ialisation Traffic and Mobility: Elective Compulso	bry	
	Civil- and Environmental Engineering: Speci	ialisation Water and Environment: Elective Com	pulsory	
	For some and Fourier states for states days	re qualification: Compulsory		
	Energy and Environmental Engineering: Cor			
		am, 7 semester): Specialisation Energy and Env	iromental Engineer	ing: Compulsory
	General Engineering Science (English progra General Engineering Science (English pro	am, 7 semester): Specialisation Energy and Env ogram, 7 semester): Specialisation Mechanica	-	
	General Engineering Science (English progra General Engineering Science (English pro Elective Compulsory		l Engineering, Foc	cus Energy Syste

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

Course L0315: Energy 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 En	iergy
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 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

Courses							
Title				Тур	Hrs/wk	СР	
Practical Course: Measurement and Control Systems (L1119)				Practical Course	2	2	
Measurement Technology for Mechanical Engineering (L1116)				Lecture	2	3	
Measurement Technology for Mech	nanical Engineering (L11	.18)		Recitation Section (large)	1	1	
Module Responsible	Prof. Thorsten Kern						
Admission Requirements	None						
Recommended Previous	Basic knowledge of p	physics, chemistry and ele	ectrical engineering				
Knowledge							
Educational Objectives	After taking part suc	cessfully, students have r	eached the followin	g learning results			
Professional Competence							
Knowledge		o name the most importa nd Dynamic Properties of			ogy (Quantities and	d Units, Uncertain	
	They can outline the	e most important measur	ing methods for dif	ferent kinds of quantities	s to be maesured (Electrical Quantiti	
	Temperature, mecha	anical quantities, Flow, Ti	me, Frequency).				
	They can describe in	nportant methods of chen	nical Analysis (Gas S	ensors, Spectroscopy, Ga	s Chromatography)		
Skills	Students can select :	suitable measuring metho	ods to given problem	ns and can use refering m	easurement device	s in practice.	
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well a						
	place the issues into	the right context and app	lication area.				
Personal Competence							
		at work results in groups a	and document them	in a common report.			
Autonomy	Students are able to	familiarize themselves wi	th new measureme	nt technologies.			
Workload in Hours	Independent Study T	Γime 110, Study Time in L	ecture 70				
Credit points	6						
Course achievement		Form	Description				
	Yes None	Subject theoretical	and				
		practical work					
	Subject theoretical a	nd practical work					
Examination duration and							
scale							
		Science (German program					
Following Curricula		Science (German program					
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory						
		Digital Mechanical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory					
	Digital Mechanical Er			ulcon/			
	Digital Mechanical Er Energy and Environn	mental Engineering: Core	qualification: Compu	Ilsory			
	Digital Mechanical Er Energy and Environn Engineering Science:	mental Engineering: Core : Specialisation Mechatror	qualification: Compunics: Compulsory	-			
	Digital Mechanical Er Energy and Environn Engineering Science: Engineering Science:	nental Engineering: Core : Specialisation Mechatror : Specialisation Mechanica	qualification: Compu nics: Compulsory al Engineering: Com	pulsory			
	Digital Mechanical Er Energy and Environn Engineering Science Engineering Science Engineering Science	nental Engineering: Core a : Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica	qualification: Compu nics: Compulsory al Engineering: Com al Engineering: Elect	pulsory ive Compulsory	iromental Engineeri	ina: Compulsory	
	Digital Mechanical Er Energy and Environn Engineering Science: Engineering Science: Engineering Science: General Engineering	nental Engineering: Core : Specialisation Mechatror : Specialisation Mechanica	qualification: Compu nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env	5	5 1 5	
	Digital Mechanical Er Energy and Environn Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering	nental Engineering: Core (: Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program	qualification: Compu- nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi	ineering: Compulso	ry	
	Digital Mechanical Er Energy and Environn Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering	nental Engineering: Core (: Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program Science (English program	qualification: Compu- nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi	ineering: Compulso ineering: Compulso	ry	
	Digital Mechanical Er Energy and Environn Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering	mental Engineering: Core : Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program Science (English program Science (English program	qualification: Compu nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi ialisation Mechatronics: C	ineering: Compulso ineering: Compulso Compulsory	ry ry	
	Digital Mechanical Er Energy and Environn Engineering Sciences Engineering Sciences General Engineering General Engineering General Engineering General Engineering General Engineering	mental Engineering: Core : Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program Science (English program Science (English program Science (English program	qualification: Compu nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec n, 7 semester): Spec n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi ialisation Mechatronics: C ialisation Mechanical Engi	ineering: Compulso ineering: Compulso Compulsory ineering: Compulso	ry ry ry	
	Digital Mechanical Er Energy and Environn Engineering Sciences Engineering Sciences General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering	mental Engineering: Core : Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program Science (English program Science (English program Science (English program Science (English program	qualification: Compu nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi ialisation Mechatronics: C ialisation Mechanical Engi ialisation Biomedical Engi	ineering: Compulso ineering: Compulso compulsory ineering: Compulso ineering: Elective Co	ry ry ry	
	Digital Mechanical Er Energy and Environn Engineering Sciences Engineering Sciences General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering Logistics and Mobility	mental Engineering: Core (: Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program Science (English program Science (English program Science (English program Science (English program Science (English program	qualification: Compu- nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi ialisation Mechatronics: C ialisation Mechanical Engi ialisation Biomedical Engi	ineering: Compulso ineering: Compulso compulsory ineering: Compulso ineering: Elective Co	ry ry ry	
	Digital Mechanical Er Energy and Environn Engineering Sciences Engineering Sciences General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering Logistics and Mobility Mechanical Engineer	mental Engineering: Core (: Specialisation Mechatror : Specialisation Mechatror : Specialisation Biomedica Science (English program Science (English program Science (English program Science (English program Science (English program Science (English program y: Specialisation Production	qualification: Compu- nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi ialisation Mechatronics: C ialisation Mechanical Engi ialisation Biomedical Engi	ineering: Compulso ineering: Compulso compulsory ineering: Compulso ineering: Elective Co	ry ry ry	
	Digital Mechanical Er Energy and Environn Engineering Sciences Engineering Sciences General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering Logistics and Mobility Mechanical Engineer	mental Engineering: Core : Specialisation Mechatror : Specialisation Mechanica : Specialisation Biomedica Science (English program Science (English program Science (English program Science (English program Science (English program Science (English program y: Specialisation Productio ring: Core qualification: Co	qualification: Compu- nics: Compulsory al Engineering: Com al Engineering: Elect n, 7 semester): Spec n, 7 semester): Spec	pulsory ive Compulsory ialisation Energy and Env ialisation Mechanical Engi ialisation Biomedical Engi ialisation Mechatronics: C ialisation Mechanical Engi ialisation Biomedical Engi Processes: Elective Comp	ineering: Compulso ineering: Compulso compulsory ineering: Compulso ineering: Elective Co pulsory	ry ry ompulsory	

rse L1119: Practical Cour	rse: Measurement and Control Systems
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe/SoSe
Content	Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseou pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications wit 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. Auff Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbur Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 BI.1, 2451 BI.4, 2453 BI.5, 2455 BI.1 Versuch 2: Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

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

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

Module M0655: Comp	utational Fluid Dynamics I			
Courses				
Title		Typ	Hrs/wk	СР
Computational Fluid Dynamics I (L0	1235)	Typ Lecture	2	3
Computational Fluid Dynamics I (LO		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Mathematical Methods for Engineers 			
	 Fundamentals of Differential/integral calculution 	us and series expansions		
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence		5 5		
-	The students are able to list the basic numerics of	partial differential equations.		
Skills	The students are able develop appropriate numeri	ical integration in space and time for the go	overning partial d	ifferential equation
	They can code computational algorithms in a struc			
Personal Competence				
Social Competence	The students can arrive at work results in groups a	and document them.		
Autonomy	The students can independently analyse approaches to solving specific problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lectur	ire 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 Engi	neering, Focus Th	eoretical Mechanic
	Engineering: Elective Compulsory		-	
	General Engineering Science (German program,	, 7 semester): Specialisation Mechanical	Engineering, Foo	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			
	General Engineering Science (German program, 7		omental Enginee	ring: Compulsory
	Energy Systems: Technical Complementary Course			
	General Engineering Science (English program, 7 s		-	
	General Engineering Science (English program,	/ semester): Specialisation Mechanical I	Engineering, Foc	us Energy System
	Elective Compulsory	competer), Specialization Noval Architecture	Compulson	
	General Engineering Science (English program, 7 s			us Aircraft System
	General Engineering Science (English program, Engineering: Elective Compulsory	, semester), specialisation Mechanical	Lingineering, FOC	us Alluidit Syster
	Mechanical Engineering: Specialisation Energy Sys	stems: Elective Compulsory		
	. icenanical Engineering. Specialisation Energy Sys	sterios Liective compaisory		
	Mechanical Engineering: Specialisation Aircraft Sys	stems Engineering: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft Sys 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	rse L0419: Computational Fluid Dynamics I		
Тур	Recitation Section (large)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Thomas Rung		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Madula M1075, Envir	an mantal Task				
Module M1275: Envir	onmental lech	nology			
Courses					
Title			Тур	Hrs/wk	СР
Practical Exercise Environmental T	echnology (L1387)		Practical Course	1	1
Environmental Technologie (L0326	,)		Lecture	2	2
Module Responsible	Prof. Martin Kaltschm	nitt			
Admission Requirements	None				
Recommended Previous	Fundamentals of inor	rganic/organic chemistry	and biology		
Knowledge					
Educational Objectives	After taking part succ	cessfully, students have r	reached the following learning results		
Professional Competence					
Knowledge	With the completion	of this modul the student	ts obtain profound knowledge of environme	ntal technology. They	are able to descri
	the behaviour of che	micals in the environme	nt. Students can give an overview of scient	tific disciplines involv	ed. They can expl
	terms and allocate th	nem to related methods.			
Skills	Skills Students are able to propose appropriate management and mitigation measures for environmental problems. They				
	determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students				
		•	onmental Technology contributes to sustain	nable development, a	ind 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-s	pecific and multidisci	olinary. They are a
	to develop different a	approaches to the task as	s a group as well as to discuss their theoreti	cal or practical imple	mentation.
Autonomy	Students can indeper	ndently exploit sources a	bout of the subject, acquire the particular k	nowledge and tranfer	it to new problem
Workload in Hours	Independent Study T	ime 48, Study Time in Le	ecture 42		
Credit points	3				
Course achievement		Form	Description		
	Yes None	Subject theoretical	and		
		practical work			
Examination					
Examination duration and					
scale					
Assignment for the	General Engineering	Science (German program	m, 7 semester): Specialisation Process Engi	neering: Elective Com	pulsory
Following Curricula			m, 7 semester): Specialisation Bioprocess E		
			m, 7 semester): Specialisation Energy and E	Enviromental Enginee	ring: Compulsory
	Diangacase Engineeri	ing: Core qualification: Ele			
	Energy and Environm	nental Engineering: Core	qualification: Compulsory		
	Energy and Environm General Engineering	nental Engineering: Core Science (English progran	qualification: Compulsory n, 7 semester): Specialisation Bioprocess Er		
	Energy and Environm General Engineering General Engineering	nental Engineering: Core Science (English progran Science (English progran	qualification: Compulsory n, 7 semester): Specialisation Bioprocess Er n, 7 semester): Specialisation Energy and E	nviromental Engineer	ng: Compulsory
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cise Environmental Technology
Practical Course
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Independent Study Time 16, Study Time in Lecture 14
Prof. Martin Kaltschmitt, Dr. Isabel Höfer
DE
SoSe
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.

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Course L0326: Environmenta	ıl 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				
Fitle		Тур	Hrs/wk	СР
ntroduction to Control Systems (L06	654)	Lecture	2	4
ntroduction to Control Systems (L06	655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
	Representation of signals and systems i	n time and frequency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	 Students can represent dynamic 	system behavior in time and frequency domain, and	can in particular	explain properties
	first and second order systems	-,,,,,,		
	They can explain the dynamics of	f simple control loops and interpret dynamic propertie	es in terms of free	quency response a
	root locus			
	 They can explain the Nyquist stat 	pility criterion and the stability margins derived from	it.	
		phase margin in analysis and synthesis of control loop		
		ontroller affects a control loop in terms of its frequence		digitally
	 They can explain issues arising w 	hen controllers designed in continuous time domain a	are implemented	uigitally
Skills	 Students can transform models or 	f linear dynamic systems from time to frequency dom	ain and vice vers	a
		e behavior of systems and control loops		u .
		vith the help of heuristic (Ziegler-Nichols) tuning rules	;	
	 They can analyze and synthesize 	simple control loops with the help of root locus and f	requency respons	e techniques
	 They can calculate discrete-time 	ne approximations of controllers designed in cor	ntinuous-time and	d use it for digi
	implementation			
	 They can use standard software t 	cools (Matlab Control Toolbox, Simulink) for carrying o	out these tasks	
Personal Competence				
Social Competence	Students can work in small groups to joi	ntly solve technical problems, and experimentally va	lidate their contro	ller designs
Autonomy	Students can obtain information from	provided sources (lecture notes, software document	tation, experimen	t guides) and use
	when solving given problems.			
	They can assess their knowledge in wee	kly on-line tests and thereby control their learning pr	ogress.	
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Workload in Hours	Independent Study Time 124, Study Tim	ao in Locturo 56		
Credit points				
Course achievement				
	Written exam			
Examination				
Examination Examination duration and	120 min			
	120 min			
Examination duration and scale		rogram 7 semester): Core qualification: Compulson		
Examination duration and scale	General Engineering Science (German p	rogram, 7 semester): Core qualification: Compulsory on: Compulsory		
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German p Bioprocess Engineering: Core qualification	on: Compulsory		
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German p Bioprocess Engineering: Core qualification	on: Compulsory utational Mathematics: Elective Compulsory		
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German p Bioprocess Engineering: Core qualificatio Computer Science: Specialisation Comp	on: Compulsory utational Mathematics: Elective Compulsory e Compulsory		
Examination duration and scale Assignment for the Following Curricula	General Engineering Science (German p Bioprocess Engineering: Core qualificatio Computer Science: Specialisation Comp Data Science: Core qualification: Electiv	on: Compulsory utational Mathematics: Elective Compulsory e Compulsory n: Compulsory		
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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 two and stady state error, error constants
	System type and steady-state error, error constantsInternal 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 equationsTustin 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	urse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Typ Lecture Recitation Section (small) Recitation Section (large) Practical Course g learning results es of separation processes concentration during a sepa ring, and the selection of sep ration processes and devices sonable system boundary fo use designing of a separation aration process for a given eded material properties from s in the experimental lab worl and the content of the ex he content of other lectures I mechanics and chemical en ups and present the combine	aration process, paration systems s or a given separa n process and o n case based on m appropriate so rk. xperimental work	the estimation of s ation process and define the amount the advantages a ources (diagrams a k with the teachers
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concentration during a sepa ving, and the selection of sep ration processes and devices sonable system boundary fo he designing of a separation aration process for a given aded material properties from s in the experimental lab work and and the content of the ex he content of other lectures I mechanics and chemical en	aration process, paration systems s or a given separa n process and o n case based on m appropriate so rk. xperimental work	the estimation of s ation process and define the amount the advantages a ources (diagrams a k with the teachers
e designing of a separation aration process for a given eded material properties from s in the experimental lab work and and the content of the ex he content of other lectures I mechanics and chemical en	n process and on a case based on m appropriate so rk. xperimental work and use it toget	define the amount the advantages a ources (diagrams a k with the teachers
mall groups and organize a nt them scientifically in a rep from suitable sources by the th exam resembling assign	a functional divis port. nemselves and as	sion of labor betwo ssess their quality
cialisation Bioprocess Engine cialisation Green Technologi cialisation Energy and Enviro re Compulsory cialisation Bioprocess Engine cialisation Energy and Enviro cialisation Process Engineerir	eering: Compuls ies, Focus Renev omental Enginee eering: Compulsco omental Enginee ng: Compulsory	ory wable Energy: Elec ering: Compulsory ory
	ecialisation Bioprocess Engin ecialisation Green Technolog ecialisation Energy and Envir ve Compulsory cialisation Bioprocess Engine cialisation Energy and Envir cialisation Process Engineeri	cialisation Bioprocess Engineering: Compulse cialisation Energy and Enviromental Enginee cialisation Process Engineering: Compulsory gy Systems: Elective Compulsory

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

Тур	Recitation Section (small)
Hrs/wk	
	2
	– Independent Study Time 32, Study Time in Lecture 28
	Prof. Irina Smirnova
Language	
Cycle	
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes
	Distillation of binary mixtures, enthalpy-concentration diagrams
	Extractive and azeotrope distillation, water vapor distillation, stepwise distillation
	Extraction: separation ternary systems, ternary diagram
	Multiphase separation including complex mixtures
	 Designing of separation devices without discrete stages
	• Drying
	Chromatographic separation processes
	Membrane separation
	Energy demand of separation processes
	Advance overview of separation processes
	Selection of separation processes
-	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 separa 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 19 Ullmann"s Enzyklopädie der Technischen Chemie

Тур	Recitation Section (large)
Hrs/wk	
CP	
_	- Independent Study Time 16, Study Time in Lecture 14
	Prof. Irina Smirnova
Language	
Cycle	
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes
Literature	 Selection of separation processes G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separatic processes. Steinkopff, Darmstadt; Springer, New York; 194. 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

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
Content	takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They
	receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Module M0538: Heat	and Mass Transfer
Courses	
Title	Typ Hrs/wk CP
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	None
	Basic knowledge: Technical Thermodynamics
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	 heat exchanger, chemical reactors). They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative by using suitable mass transfer theories. They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail. The students are able to set reasonable system boundaries for a given transport problem by using the gained knowledge and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluids and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column, rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a specific application considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses (lip particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technical process engineering to solve concret technical process engineering) to solve concret technical process engineering to solve concret technical process engineering to solve concrete technical application considering their advantages and dis
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	 The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonable manner to tutors and other students. The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicked)
	system, exam-like assignments) and on this basis they can control their learning processes.
	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and	120 minutes: theoretical questions and calculations
	120 minutes; theoretical questions and calculations
scale	
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
scale	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
scale Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

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

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

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		

Courses					
Title		Тур	Hrs/wk	СР	
Environmental Assessment (L0860)		Lecture	2	2	
Environmental Assessment (L1054)		Recitation Section (small)	1	1	
Module Responsible	Prof. Martin Kaltschmitt				
Admission Requirements	None				
Recommended Previous	Fundamentals of inorganic/organic chemistry and	l biology			
Knowledge					
Educational Objectives	After taking part successfully, students have read	hed the following learning results			
Professional Competence					
Knowledge	With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects or construction measures. They have knowledg about the methodological diversity and are competent in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertainties an difficulties with their measurement.				
Skills	The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby 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 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 tech to develop jointly different solutions and to dis topics, the students receive insights into the mu Their sensitivity and consciousness towards the social responsibilities in their role as engineers.	cuss their theoretical or practical implementation in the protocol labeled issues of the environment protocol protocol in the environment protocol is the environment prot	entation. Due to tion and the con	the selected lectu cept of sustainabilit	
Autonomy	The students learn to research, process and pr scientific work. They can solve an environmental				
Workload in Hours	Independent Study Time 48, Study Time in Lectu	re 42			
Credit points					
Course achievement					
Examination					
Examination duration and scale	1 hour written exam				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Process Engineer	ing: Elective Cor	npulsory	
5	General Engineering Science (German program,		5	1 5	
-	General Engineering Science (German program,	7 semester): Specialisation Energy and Envir	omental Enginee	ering: Compulsory	
	Bioprocess Engineering: Core qualification: Electi	ve Compulsory			
	Energy and Environmental Engineering: Core qua	lification: Compulsory			
	General Engineering Science (English program, 7	semester): Specialisation Bioprocess Engine	eering: Elective C	Compulsory	
	General Engineering Science (English program, 7 General Engineering Science (English program, 7				

Course L0860: Environmenta	l 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
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
Particle Technology I (L0434)				Lecture	2	3
Particle Technology I (L0435)				Recitation Section (small)	1	1
Particle Technology I (L0440)				Practical Course	2	2
Module Responsible	Prof. Stefan Heinrich	1				
Admission Requirements	None					
Recommended Previous	keine					
Knowledge						
Educational Objectives	After taking part suc	ccessfully, students h	nave reached the follow	ing learning results		
Professional Competence						
Knowledge	After successful com	npletion of the modu	le students are able to			
	• name and eve	plain processes and	unit-operations of solid	le procose onginooring		
			tributions and to discus			
		particles, particle dis		s their bulk properties		
Skills	Students are able to)				
				processing according to the d	esired solids prop	perties of the produ
			behavior in solids proce	essing steps		
	 document the 	eir work scientifically				
Personal Competence						
Social Competence	The students are al	ble to discuss scien	tific topics orally with	other students or scientific p	personal and to o	develop solutions f
	technical-scientific issues in a group.					
Autonomy	Students are able to	analyze and solve o	juestions regarding soli	d particles independently.		
Workload in Hours	Independent Study T	Time 110, Study Tim	e in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Written elaborati	on sechs Berich	nte (pro Versuch ein Bericht) à	a 5-10 Seiten	
Examination	Written exam					
Examination duration and	90 minutes					
scale						
Assignment for the	General Engineering	g Science (German p	rogram, 7 semester): Sr	pecialisation Process Engineer	ring: Compulsory	
Following Curricula	General Engineering	g Science (German p	rogram, 7 semester): Sr	pecialisation Bioprocess Engir	eering: Compulso	bry
Following Curricula	Conoral Engineering	g Science (German p	rogram, 7 semester): Sp	pecialisation Energy and Envi	romental Enginee	ring: Compulsory
Following Curricula	General Engineering		rogram 7 semester). c	Specialisation Green Technolo	gies, Focus Wate	r and Environment
ronowing curricula		g Science (German p	nogram, / semester/r t			
			iogram, / semester, i			
	General Engineering	e Compulsory	-			
	General Engineering Engineering: Elective Bioprocess Engineer	e Compulsory ring: Core qualificatio	-			
	General Engineering Engineering: Elective Bioprocess Engineer Energy and Environr	e Compulsory ring: Core qualificatio mental Engineering:	on: Compulsory Core qualification: Elect		eering: Compulso	ry
	General Engineering Engineering: Elective Bioprocess Engineer Energy and Environr General Engineering	re Compulsory ring: Core qualificatio mental Engineering: g Science (English pr	on: Compulsory Core qualification: Elect ogram, 7 semester): Spo	tive Compulsory		
	General Engineering Engineering: Elective Bioprocess Engineer Energy and Environr General Engineering General Engineering	e Compulsory ring: Core qualificatio mental Engineering: g Science (English pr g Science (English pr	on: Compulsory Core qualification: Elect ogram, 7 semester): Sp ogram, 7 semester): Sp	tive Compulsory ecialisation Bioprocess Engine	omental Engineer	
	General Engineering Engineering: Elective Bioprocess Engineer Energy and Environr General Engineering General Engineering General Engineering	e Compulsory ring: Core qualification mental Engineering: g Science (English pro g Science (English pro g Science (English pro	on: Compulsory Core qualification: Elect ogram, 7 semester): Sp ogram, 7 semester): Sp ogram, 7 semester): Sp	tive Compulsory ecialisation Bioprocess Engine ecialisation Energy and Envire	omental Engineer	

Course L0434: Particle Techr	
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 Tech	nology I
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Stefan Heinrich
Language	DE/EN
Cycle	SoSe
Content	 Sieving Bulk properties Size reduction Mixing Gas cyclone Blaine-test, filtration Sedimentation
Literature	Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992.

Courses						
Title			-	Гур	Hrs/wk	СР
Process and Plant Engineering I (L0095)				Lecture	2	2
Process and Plant Engineering I (L0				Recitation Section (large)	1	2
Process and Plant Engineering I (L1	214)		F	Recitation Section (small)	1	2
Module Responsible	Prof. Mirko Skiborows	ki				
Admission Requirements	None					
Recommended Previous	unit operation of them	mal an dmechanical se	paration processes			
Knowledge	chemical reactor eingineering					
Educational Objectives	After taking part succ	essfully, students have	reached the following	learning results		
Professional Competence	· · · · · · · · · · · · · · · · · · ·			,		
	students can:					
	classify and formulate	e blobal balance equation	ons of chemical proce	sses		
	specify linear compon	ent equations of compl	ex chemical processe	S		
	explain linear regress	ion and data reconcillia	tion problems			
	explain pfd-diagrams					
Skills	 students are capable of formulation of mass and energy balance equations and estimation of product streams 					
			cal plants using linear	component balance model	5	
	 solution of data reco conduction of procession 					
		n of processes and the e	estimation of producti	on costs		
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Ti	me 124, Study Time in	Lecture 56			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 10 %	Subject theoretical	and			
		practical work				
Examination	Written exam					
Examination duration and scale	120 Min. lectures note	es and books				
Assignment for the	General Engineering S	Science (German progra	am, 7 semester): Spec	cialisation Process Engineer	ing: Compulsory	
Following Curricula	General Engineering	Science (German progra	am, 7 semester): Spec	cialisation Bioprocess Engin	eering: Compulso	iry
	Bioprocess Engineerir	ng: Core qualification: C	ompulsory			
	General Engineering	Science (English progra	m, 7 semester): Spec	alisation Bioprocess Engine	ering: Compulsor	У
	General Engineering	Science (English prog	gram, 7 semester):	Specialisation Energy and	Enviromental E	ngineering: Elect
	Compulsory					
	General Engineering S	Science (English progra	m, 7 semester): Spec	alisation Process Engineeri	ng: Compulsory	
	Green Technologies: E	Energy, Water, Climate:	Specialisation Biores	ource Technology: Elective	Compulsory	
	Process Engineering:	Core qualification: Com	pulsory			

ourse L0095: Process and P	lant Engineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Mirko Skiborowski
Language	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,
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	G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19
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	G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133
	U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000
	J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991
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	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

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

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				
		T	I loss foods	<u></u>
Fitle Management Tutorial (L0882)		Typ Recitation Section (small)	Hrs/wk	CP 3
ntroduction 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 th	e following learning results		
Professional Competence				
Knowledge	After taking this module, students know the important and Organisation to Marketing and Innovation, and also			
	 explain the differences between Economics a important definitions from the field of Management 		lines in Manage	ment and to na
	 explain the most important aspects of and goal 	s in Management and name the mos	t important aspe	cts of entreprneu
	projects			
	 describe and explain basic business functions 			-
	 organization and human ressource management, explain the relevance of planning and decisio 			
	uncertainty, and explain some basic methods fro		tions under mu	tiple objectives
	 state basics from accounting and costing and sel 			
Skills	Students are able to analyse business units with respect out an Entrepreneurship project in a team. In particular,		ijectives, strategi	ies etc.) and to ca
	 analyse Management goals and structure them a 	ppropriately		
	analyse organisational and staff structures of cor	npanies		
	apply methods for decision making under multipl	e objectives, under uncertainty and un	nder risk	
	 analyse production and procurement systems an 	d Business information systems		
	 analyse and apply basic methods of marketing 			
	 select and apply basic methods from mathematic 	cal finance to predefined problems		
	 apply basic methods from accounting, costing an 	d controlling to predefined problems		
Personal Competence				
	Students are able to			
,				
	work successfully in a team of students			
	 to apply their knowledge from the lecture to an e 	entrepreneurship project and write a co	oherent report on	the project
	 to communicate appropriately and 			
	 to cooperate respectfully with their fellow studen 	its.		
Autonomy	Students are able to			
		h en e		
	 work in a team and to organize the team themse 	Ives		
	 to write a report on their project. 			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination	Subject theoretical and practical work			
	several written exams during the semester			
scale				
	General Engineering Science (German program, 7 seme			
Following Curricula	Civil- and Environmental Engineering: Specialisation Civ			
	Civil- and Environmental Engineering: Specialisation Wa Civil- and Environmental Engineering: Specialisation Tra		-	
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Data Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualificati	on: Compulsory		
	General Engineering Science (English program, 7 semes		ring: Compulsory	
	General Engineering Science (English program, 7 seme			
	General Engineering Science (English program, 7 seme			гу
	General Engineering Science (English program, 7 seme	ster): Specialisation Energy and Enviro	mental Engineeri	ing: Compulsory
	General Engineering Science (English program, 7 semes	ster): Specialisation Computer Science	: Compulsory	
	General Engineering Science (English program, 7 s	semester): Specialisation Mechanica	Engineering, F	ocus Biomechan
	Compulsory			
	Compulsory General Engineering Science (English program, 7 se	mester): Specialisation Mechanical I	Engineering, Foc	us Energy Syste
	Compulsory General Engineering Science (English program, 7 se Compulsory			
	Compulsory General Engineering Science (English program, 7 se			

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 in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	r 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 s 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.			

[215]

Course L0880: Introduction t	purse L0880: Introduction 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. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corn		
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, 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.		

Modulo M0901, Infor	matics for Drospes Engineers					
	matics for Process Engineers					
Courses						
Title		т	ур	Hrs/wk	СР	
nformatics for Process Engineers (L0836)	L	ecture	2	2	
Informatics for Process Engineers (L0837)	R	ecitation Section (small)	2	2	
Numeric and Matlab (L0125)	Practical Course 2 2			2		
Module Responsible	Dr. Marcus Venzke					
Admission Requirements	None					
Recommended Previous	Basic knowledge in using MS Windows.					
Knowledge						
Educational Objectives	After taking part successfully, students ha	ve reached the following	learning results			
Professional Competence						
Knowledge	Students can describe procedural and obje	ect-oriented concepts.				
Skills	Students are capable of object-oriented p using Matlab.	programming in the prog	gramming in the programing language Java and of solving mathematic questions by			
	Students are capable of developing conce	pts (simple algorithms) t	o solve technical questions			
Personal Competence						
-	Students are able to work out solutions to	gether in small groups				
Social competence	Stadents are usic to work out solutions to	getiler in small groups.				
Autonomy	Students are able to assess acquired skills	s by applying it in practic	<u>م</u>			
Autonomy		by applying it in practic				
Workload in Hours	Independent Study Time 96, Study Time in	n Lecture 84				
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	90 min					
scale						
Assignment for the	General Engineering Science (English prog	gram, 7 semester): Speci	alisation Process Engineeri	ng: Elective Com	oulsory	
Following Curricula	General Engineering Science (English p	program, 7 semester): 9	Specialisation Energy and	Enviromental E	ingineering: Election	
	Compulsory					

se L0836: Informatics fo	
	Lecture
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marcus Venzke
Language	DE
Cycle	SoSe
Content	Introduction to object-oriented modelling and programming exemplified with Java
	Objects, classes
	Methods, properties
	Inheritance
	Basics of the language Java
	Sample application: Simulation of an electricity network
	• 2D graphics
	Events and Controls
Literature	Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusel
	1998. Bibliothek: TII 978
	Bibliotnek: 11 978
	Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002.
	http://www.javabuch.de/
	Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999.
	Bibliothek: TII 717
	Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999.
	Bibliothek: TII 942
	Java SE 7 Documentation
	- http://docs.oracle.com/javase/7/docs/
	Java Platform, Standard Edition 7 API Specification
	http://docs.oracle.com/javase/7/docs/api/

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

Course L0125: Numeric and	Matlab
Tvn	Practical Course
Hrs/wk	
CP	
-	Independent Study Time 32, Study Time in Lecture 28
	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	
Cycle	
Content	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil):
	 Moler, C., Numerical Computing with MATLAB, SIAM, 2004 The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Courses					
Title			Тур	Hrs/wk	СР
Computer Science for Engineers - F	rogramming Concepts, Data Handl	ing & Communication (L2689)	Lecture	3	3
	rogramming Concepts, Data Handl		Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Fröschle				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, s	tudents have reached the follo	wing learning results		
Professional Competence					
Knowledge					
Skills					
- 10 ·					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 110, S	study Time in Lecture 70			
Credit points		Description			
Course achievement	Compulsory Bonus Form No 10 % Attestat	Description Testate fir	den semesterbegleitend statt.		
Examination			ach semesterbegietena statt.		
Examination duration and					
scale	120 11111				
	General Engineering Science	(German program 7 semes	ter): Specialisation Mechanica	l Engineering E	ocus Biomechani
	Compulsory	(German program, 7 series	ter). Specialisation mechanica	r Engineering, r	ocus biomecham
· · · · · · · · · · · · · · · · · · ·		ierman program. 7 semester):	Specialisation Process Engineer	ina: Compulsorv	
			Specialisation Biomedical Engin		rv
			Specialisation Green Technologi		
	Compulsory				5,
		(German program, 7 semeste	er): Specialisation Mechanical I	Engineering, Foci	us Energy System
	Compulsory			5 5.	5, ,
	General Engineering Science	(German program, 7 semeste	er): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	Engineering: Compulsory				
	General Engineering Science	(German program, 7 seme	ster): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compuls	ory			
	General Engineering Science	(German program, 7 semes	ster): Specialisation Mechanica	l Engineering, F	ocus Mechatroni
	Compulsory				
		German program, 7 semester):	Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechani
	Engineering: Compulsory				
			Specialisation Mechanical Engi	ineering, Focus P	roduct Developme
	and Production: Elective Compu		Createlization Flactrical Fraince	vina, Flastiva Ca	
			Specialisation Electrical Enginee	ering: Elective Col	mpulsory
	Bioprocess Engineering: Core q Electrical Engineering: Core qua				
	Energy and Environmental Engl		mulsory		
			Specialisation Process Engineerir	na: Elective Comr	ulsory
			er): Specialisation Energy and		-
	Compulsory	(English program, 7 semest	si, opecialoución Energy ana	Entri onici al E	ingineering: Lieet
		ater, Climate: Specialisation E	nergy Systems: Elective Compul	sory	
	Logistics and Mobility: Core qua			-	
	Logistics and Mobility: Specialis		Compulsory		
	Mechatronics: Core qualification				
	Process Engineering: Core qual	ification: Compulsory			

Course L2689: Computer Science for Engineers - Programming Concepts, Data Handling & Communication		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Sibylle Fröschle	
Language	DE	
Cycle	SoSe	
Content		
Literature	John V. Guttag: Introduction to Computation and Programming Using Python.	
	With Application to Understanding Data. 2nd Edition. The MIT Press, 2016.	

Course L2690: Computer Science for Engineers - Programming Concepts, Data Handling & Communication		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Fröschle	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Specialization Computer Science

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

Module M0561: Discre	ete Algebraic Structures				
Courses					
Title			Тур	Hrs/wk	СР
Discrete Algebraic Structures (L016	54)		Lecture	2	3
Discrete Algebraic Structures (L016				3	
Module Responsible	Prof. Karl-Heinz Zimmermann				
Admission Requirements	None				
Recommended Previous	Mathematics from High School.				
Knowledge					
Educational Objectives	After taking part successfully, students have re	ached the followir	ng learning results		
Professional Competence					
Knowledge	The students know the important basics of dis groups, rings, fields, finite fields, and vector spa homomorphisms.	-	-	-	
	Students are able to formalize and analyze basi	ic discrete algebra	aic structures.		
Personal Competence					
Social Competence	Students are able to solve specific problems alone or in a group and to present the results accordingly.				
Autonomy	Students are able to acquire new knowledge classes.	from specific sta	ndard books and to associa	te the acquired	knowledge to other
Workload in Hours	Independent Study Time 124, Study Time in Le	cture 56			
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German program	, 7 semester): Spe	ecialisation Computer Science	: Compulsory	
Following Curricula	Computer Science: Core qualification: Compulse	ory			
	Data Science: Core qualification: Compulsory				
	General Engineering Science (English program,	7 semester): Spe	cialisation Computer Science:	Compulsory	
	Computational Science and Engineering: Core of	qualification: Com	pulsory		
	Orientierungsstudium: Core qualification: Electi	ve Compulsory			

Course L0164: Discrete Alge	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 Alge	ourse L0165: Discrete Algebraic Structures		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Karl-Heinz Zimmermann		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

MUTSAS				
Courses		Typ	Hrs/wk	СР
Computer Engineering (L0321)		Typ Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence	This module deals with the foundations of the fu	unctionality of computing systems. It sayon	a the lowers from	a the accombly l
interneuge	programming down to gates. The module includes			T the assembly h
	 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 	matic hardware design raction, multiplication and division ing models, MIPS single-cycle architecture,		works
	Input/output: I/O from the perspective of the		oint connections,	busses
Chille	The students perceive computer systems from the	architect's perspective i.e. they identify t	he internal struct	ure and the phys
SKIIIS	composition of computer systems. The students composition of computer systems.			
	collection of few and simple components. They a		-	
	today's computing systems - from gates and circu	its up to complete processors.		
	After successful completion of the module, the s	tudents are able to judge the interdepend	encies between	a physical comp
	system and the software executed on it. In particu			
	on the hardware-centric abstraction layers from the	he assembly language down to gates. This	way, they will be	enabled to eval
	the impact that these low abstraction levels have	on an entire system's performance and to p	ropose feasible c	ptions.
Personal Competence				
Social Competence	Students are able to solve similar problems alone	or in a group and to present the results acco	ordingly.	
Autonomy	Students are able to acquire new knowledge from	specific literature and to associate this know	wlodgo with otho	r classos
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points				
Course achievement	Compulsory Bonus Form Yes 10 % Excercises	Description		
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 Science	e: Compulsory	
Following Curricula	General Engineering Science (German program, 7			iry
	General Engineering Science (German program, 7	•		
	General Engineering Science (German program, 7	semester): Specialisation Electrical Enginee	rina: Compulsory	
		competer), Englication Riemodical Engine		
		semester): Specialisation Biomedical Engine semester): Specialisation Energy and Enviro	eering: Compulso	ory
	General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Energy and Enviro	eering: Compulso omental Engineer	ory
	General Engineering Science (German program, 7	semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri	eering: Compulso omental Engineer ng: Compulsory	ory ring: Compulsory
	General Engineering Science (German program, 7 General Engineering Science (German program, 7	semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri	eering: Compulso omental Engineer ng: Compulsory	ory ring: Compulsory
	General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program	semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri n, 7 semester): Specialisation Mechanica	eering: Compulso omental Engineer ng: Compulsory I Engineering, I	ory ring: Compulsory Focus Mechatror
	General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory	semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri n, 7 semester): Specialisation Mechanica n, 7 semester): Specialisation Mechanica	eering: Compulso omental Engineer ng: Compulsory I Engineering, F	ory ring: Compulsory Focus Mechatror focus Biomechar
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General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Engineering		
Тур	Lecture	
Hrs/wk	3	
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	
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
Automata Theory and Formal Langi	uages (L0332)	Lecture	2	4
Automata Theory and Formal Lang	uages (L0507)	Recitation Section (small)	2	2
Module Responsible	Prof. Tobias Knopp			
Admission Requirements	None			
Recommended Previous	Participating students should be able to			
Knowledge				
	- specify algorithms for simple data structure	es (such as, e.g., arrays) to solve computational	problems	
	- apply propositional logic and predicate logi	ic for specifying and understanding mathematica	al proofs	
	- apply the knowledge and skills taught in the module Discrete Algebraic Structures			
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students can explain syntax, semantics, ar	nd decision problems of propositional logic, and	d they are able to	give algorithms
Skills	problems are hard to represent with propositional logic, and therefore, the students can motivate predicate logic, and constructs, semantics, and decision problems for this representation formalism. Students can explain unification and resolutions solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and decision problems for variants of temporal logic, and identify their application areas. The participants of the course can define various kinds of automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges deterministic and nondeterministic finite automata and pushdown automata to Turing machines. Students can name if formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which deeproblems w.r.t. other formalisms. They understand that some formalism easily induce algorithms whereas others are best is for specifying systems and their properties. Students can describe the relationships between formalisms such as logic, auto or grammars.		problems for varia rious kinds of fil explain ranges fr ts can name the trate which decis malism into decis hers are best suit n as logic, automa a analyze applicat n. They can evalu on of algorithms	
	emptiness problem in case of infinite words.			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale	General Engineering Science (German progr	am, 7 semester): Specialisation Computer Scien	ce: Elective Compu	
			ilsory	
	General Engineering Science (German progr	am, 7 semester): Specialisation Computer Scient	ce: Compulsory	ilsory
Assignment for the	General Engineering Science (German progr Computer Science: Core qualification: Comp		ce: Compulsory	ilsory
Assignment for the		ulsory	ce: Compulsory	ılsory
Assignment for the	Computer Science: Core qualification: Comp Data Science: Core qualification: Compulsory Engineering Science: Specialisation Mechatro	ulsory y onics: Elective Compulsory		
Assignment for the	Computer Science: Core qualification: Comp Data Science: Core qualification: Compulsory Engineering Science: Specialisation Mechatr General Engineering Science (English progra	ulsory y onics: Elective Compulsory am, 7 semester): Specialisation Computer Scienc	e: Elective Compul	
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Assignment for the	Computer Science: Core qualification: Comp Data Science: Core qualification: Compulsory Engineering Science: Specialisation Mechatr General Engineering Science (English progra	ulsory y onics: Elective Compulsory am, 7 semester): Specialisation Computer Scienc am, 7 semester): Specialisation Mechatronics: Ele re qualification: Compulsory	e: Elective Compul	

Course L0332: Automata The	ory and Formal Languages	
Тур	Lecture	
Hrs/wk	2	
СР	4	
Workload in Hours	dependent Study Time 92, Study Time in Lecture 28	
Lecturer	of. 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)	
	 Myhill-Nerode Theorem: Correctness of the minimization procedure, equivalence classes of strings induced by automata 	
	9. Pumping Lemma for regular languages:	
	provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive	
	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, pumping	
	lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars and	
	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		
	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	urse L0507: Automata Theory and Formal Languages		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Tobias Knopp		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0803: Embe	aaea Systems			
Courses				
Title		Тур	Hrs/wk	СР
Embedded Systems (L0805)		Lecture	3	4
Embedded Systems (L0806)	.	Recitation Section (small)	1	2
Module Responsible				
Admission Requirements				
Recommended Previous	1 5 5			
Knowledge		following loorning roculto		
Educational Objectives Professional Competence		Tonowing learning results		
Knowledge		sing systems embedded into enclos	ing products. Th	is course teaches t
raiomeage	foundations of such systems. In particular, it deals with a			
	their specification languages (models of computation, h			
	specification of real-time applications, translations betwee	en different models).		
	Another part covers the hardware of embedded system	se: Sonsors A/D and D/A convorte	rs roal time car	able communicati
	hardware, embedded processors, memories, energy diss			
	introduction into real-time operating systems, middlewa			
	systems using hardware/software co-design (hardware/so	oftware partitioning, high-level trans	sformations of s	pecifications, energ
	efficient realizations, compilers for embedded processors)	is covered.		
Skills	After having attended the course, students shall be able	to realize simple embedded syste	ams. The student	ts shall realize wh
Skiis	relevant parts of technological competences to use in ord			
	able to compare different models of computations and fe			
	which areas of embedded system design specific risks exi	st.		
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in a g	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.			er classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement		tion		
	Yes 10 % Subject theoretical and			
Frankland I.	practical work			
	Written exam			
scale	90 minutes, contents of course and labs			
Assignment for the		er): Specialisation Computer Scienc	e: Elective Comp	ulsory
Following Curricula				uisory
	Computer Science: Specialisation Computer and Software			
	Computer Science: Specialisation I. Computer and Software	re Engineering: Elective Compulsory	,	
	Electrical Engineering: Core qualification: Elective Comput	sory		
	Engineering Science: Specialisation Mechatronics: Elective			
	Aircraft Systems Engineering: Specialisation Avionic Syste			
	General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste			
	Computational Science and Engineering: Core qualification			,
	Mechatronics: Specialisation System Design: Elective Com			
	Mechatronics: Specialisation Intelligent Systems and Robo			
	Microelectronics and Microsystems: Specialisation Embed	ded Systems: Elective Compulsory		
	stems			
Course L0805: Embedded Sy				
Course L0805: Embedded Sy Typ	Lecture			
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Тур	3			
Typ Hrs/wk	3 4			
Typ Hrs/wk CP	3 4 Independent Study Time 78, Study Time in Lecture 42			
Hrs/wk CP Workload in Hours Lecturer Language	3 4 Independent Study Time 78, Study Time in Lecture 42 Prof. Heiko Falk EN			
Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle	3 4 Independent Study Time 78, Study Time in Lecture 42 Prof. Heiko Falk EN SoSe			
Typ Hrs/wk CP Workload in Hours Lecturer Language	3 4 Independent Study Time 78, Study Time in Lecture 42 Prof. Heiko Falk EN SoSe			

Introduction
 Specifications and Modeling
 Embedded/Cyber-Physical Systems Hardware
 System Software
 Evaluation and Validation
 Mapping of Applications to Execution Platforms
 Optimization

Literature

 Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber-Physical Systems. 2 nd Edition, Springer, 2012., Springer, 2012.

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

Courses				
		Tur	Line (sule	CD
Title Graph Theory and Optimization (L1	046)	Typ Lecture	Hrs/wk 2	CP 3
Graph Theory and Optimization (L1		Recitation Section (small)	2	3
Module Responsible				-
Admission Requirements				
Recommended Previous				
Knowledge	Discrete Algebraic Structures			
J.	Mathematics I			
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge				
5		ots in Graph Theory and Optimization. They are a	ble to explain the	em using appropri
	examples.			
		cions between these concepts. They are capable	of illustrating the	ese connections w
	the help of examples.			
	 They know proof strategies and can r 	reproduce them.		
Skills				
		raph Theory and Optimization with the help of	the concepts stu	udied in this cour
	Moreover, they are capable of solving them by applying established methods.			
		rify further logical connections between the conce	•	
		can develop and execute a suitable approach, a	nd are able to ci	ritically evaluate
	results.			
Personal Competence				
Social Competence	 Students are able to work together in 	n teams. They are capable to use mathematics as	a common langu:	909
		new concepts according to the needs of their coop		
	design examples to check and deepe		paraners	i norecter, and
Autonomy				
		eir understanding of complex concepts on their o	wn. They can sp	ecify open question
	precisely and know where to get help			
		persistence to be able to work for longer period	is in a goal-orien	ted manner on n
	problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
	Written exam			
Examination duration and scale	120 min			
Scale				
		ram, 7 semester): Specialisation Computer Scienc	e: Compulsory	
Following Curricula	Computer Science: Core qualification: Comp	-		
	Computer Science: Core qualification: Comp	,		
	Data Science: Core qualification: Compulsor	,		
		am, 7 semester): Specialisation Computer Science	: Compulsory	
	Logistics and Mobility: Specialisation Engine			
	Technomathematics: Specialisation I. Mathe	ematics: Elective Compulsory		

ourse L1046: Graph Theory	and Optimization
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/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	
СР	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
Objectoriented Programming, Algo	ithms and Data Structures (L0131)	Lecture	4	4
Objectoriented Programming, Algo	ithms and Data Structures (L0132)	Recitation Section (small)	1	2
Module Responsible	Prof. Rolf-Rainer Grigat			
Admission Requirements	None			
Recommended Previous	This lecture requires proficiency in the German	This lecture requires proficiency in the German language. For further requirements please refer to the German description.		
Knowledge				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	Knowledge Students can explain the essentials of software design and the design of a class architecture with reference libraries and design patterns.		ture with refere	nce to existing cla
	Students can describe fundamental data struct sorting and searching.	ures of discrete mathematics and assess the c	complexity of imp	portant algorithms
Skills	Students are able to	erns and applying class hierarchies and polym	ombion	
		ts using version management systems and Go		
Personal Competence Social 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 independ and over a period of two to three weeks.		le Test independer	
Workload in Hours	Independent Study Time 110, Study Time in Le	cture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 Minutes, Content of Lecture, exercises and r	naterial in StudIP		
scale				
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Computer Scienc	e: Elective Comp	ulsory
Following Curricula	Electrical Engineering: Core qualification: Comp			-
-	General Engineering Science (English program,		: Compulsory	
	Logistics and Mobility: Specialisation Engineerin	ng Science: Elective Compulsory	-	
	Orientierungsstudium: Core qualification: Electi	ve Compulsory		

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

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

	als and Systems	
Courses		
Title	Typ Hrs/wk	СР
Signals and Systems (L0432)	Lecture 3	4
Signals and Systems (L0433)	Recitation Section (small) 2	2
Module Responsible	Prof. Gerhard Bauch	
Admission Requirements	None	
Recommended Previous	Mathematics 1-3	
Knowledge		
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by 1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Lapla	
	but not required.	
	but not required.	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using method	s of signal and sys
	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time sign	als and systems. T
	can describe and analyse deterministic signals and systems mathematically in both time and image dom	
	understand the effects in time domain and image domain which are caused by the transition of a conti	nuous-time signal
	discrete-time signal.	
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using	-
	system theory. They can analyse and design basic systems regarding important properties such as	
D	response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time	and frequency don
Personal Competence		
	The students can jointly solve specific problems.	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can	control their leve
	knowledge during the lecture period by solving tutorial problems, software tools, clicker system.	
	Independent Study Time 110, Study Time in Lecture 70	
Credit points		
Course achievement		
	Written exam	
Examination duration and scale		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory	
Following Curricula		
· ····································	Data Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulse	ory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Comput	sory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	Focus Biomecha
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Energy Syste
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Aircraft Syst
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus N	laterials in Enginee
	Sciences: Compulsory	Feerie Mechatra
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory	, FOCUS MECHALIOI
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus	Theoretical Mechar
	Engineering: Compulsory	Theoretical Preciliar
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor	v
	General Engineering Science (English program, 7 semester): Specialisation Freese Engineering: Computer General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Computer	-
	Computational Science and Engineering: Core qualification: Compulsory	-
	Mechatronics: Core qualification: Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
Course L0432: Signals and S	ystems	
Түр	Lecture	

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 function
 - Crosscorrelation function
 - Orthogonal signals
 - Applications of correlation
- Linear time-invariant (LTI) systems
 - Linearity
 - Time-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 S	Course L0433: Signals and Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0727: Stoch	actics			
Module Mo727. Stoch				
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 reached the	ne following learning results		
Professional Competence				
Knowledge	Students can explain the main definitions of probab		-	-
	variables, events, dependence, independence assum		5	·, ·
	distributions, density functions). Students can descr	ibe characteristic notions such as e	expected values,	variance, standar
	deviation, and moments. Students can define decision			
	chain rule or Bayesian networks). Algorithms, or estima			
	an estimator, etc. Student can describe the main idea		-	-
	computation problem for stochastic processes. Student			
Skills	Students can apply algorithms for solving decision pr			
	enough in various application contexts, i.e., students ca	in derive estimators and judge whethe	r they are applic	able or reliable.
Personal Competence				
Social Competence	- Students are able to work together (e.g. on their re	egular home work) in heterogeneously	y composed tea	ms (i.e., teams from
	different study programs and background knowledge)	and to present their results appropriate	ely (e.g. during e	xercise class).
Autonomy	- Students are capable of checking their understand	ing of complex concepts on their ow	n. They can spe	ecity open questior
	precisely and know where to get help in solving them.			
	- Students can put their knowledge in relation to the co	ntants of other lactures		
	- students can put their knowledge in relation to the co	intents of other lectures.		
	- Students have developed sufficient persistence to be a	able to work for longer periods in a go	al-oriented mann	er on hard problem
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement				
	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ester): Specialisation Computer Science	e: Compulsory	
Following Curricula	Computer Science: Core qualification: Compulsory			
	Data Science: Core qualification: Compulsory			
	General Engineering Science (English program, 7 seme		: Compulsory	
	Computational Science and Engineering: Core qualificat			
	Computational Science and Engineering: Core qualificat			
	Logistics and Mobility: Specialisation Engineering Science			
	Theoretical Mechanical Engineering: Core qualification:	Elective Compulsory		

Course L0777: Stochastics	
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Christian Seifert
Language	DE/EN
Cycle	SoSe
Content	Foundations of probability theory
	Definitions of probability, conditional probability
	 Random variables, dependencies, independence assumptions,
	Marginal and joint probabilities
	Distributions and density functions
	Characteristics: expected values, variance, standard deviation, moments
	Practical representations for joint probabilities
	Bayessche Netzwerke
	Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen
	Stochastic processes
	Stationarity, ergodicity
	Correlations
	Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues
	Detection & estimation
	Detectors
	Estimation rules and procedures
	Hypothesis and distribution tests
	Stochastic regression
Literature	
	Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008 Stachastill für Informatiller, Dürsteren L., Geringer 2002
	 Stochastik für Informatiker, Dümbgen, L., Springer 2003 Statistik: Der Weg zur Datenanalyse, Eahrmein L. Künstler P., Bigget L. Tutz, G., Springer 2010.
	 Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 Stochastik, Georgii, HO., deGruyter, 2009
	 Stochastik, Georgii, HO., deGruyter, 2009 Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001
	 Probability and Random Processes, Gimmett, G., Streaker, D., Oxford University Press, 2001 Programmieren mit R, Ligges, U., Springer 2008

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

Module M0731: Funct	tional Programming				
Courses					
			Tree		СР
Fitle Functional Programming (L0624)			Typ Lecture	Hrs/wk 2	2
Functional Programming (L0625)			Recitation Section (large)	2	2
Functional Programming (L0626)			Recitation Section (small)	2	2
Module Responsible	Prof. Sibylle Schupp				
Admission Requirements					
Recommended Previous		level			
Knowledge	, , , , , , , , , , , , , , , , , , ,				
Educational Objectives	After taking part successfully, studer	ts have reached the followir	g learning results		
Professional Competence			5		
-	Students apply the principles, constr	ucts and simple design tech	iniques of functional program	nmina They dem	onstrate their ab
nnomeage	to read Haskell programs and to exp				
	errors in programs. They apply the	-			-
	unit tests of functions and simple pro			-	
	strategies.	or coordinates for partial and		ingalon laziness i	
	Stategresi				
Skills	Students break a natural-language d	escription down in parts am	enable to a formal specificat	ion and develop	a functional prog
	in a structured way. They assess	different language consi	tructs, make conscious se	elections both a	t specification
	implementations level, and justify the	eir choice. They analyze giv	ven programs and rewrite th	nem in a controll	ed way. They des
	and implement unit tests and can as	sess the quality of their tests	. They argue for the correct	ness of their prog	ram.
Personal Competence					
Social Competence	Students practice peer programmin		explain problems and solut	ions to their pee	r. They defend t
	programs orally. They communicate	n English.			
Διιτοποπγ	In programming labs, students lear	under supervision (a k a	"Betreutes Programmieren) the mechanics	of programming
Autonomy	exercises, they develop solutions ind		-) the meenanies	or programming
	exercises, they develop solutions ind	ividually and independently,	and receive reeuback.		
Workload in Hours	Independent Study Time 96, Study T	me in Lecture 84			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	Yes 15 % Excercises				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (Germa	n program, 7 semester): Spe	cialisation Computer Scienc	e: Elective Comp	ulsory
Following Curricula	Computer Science: Core qualification	: Compulsory			
-	Data Science: Core qualification: Elec				
	Engineering Science: Specialisation I		ulsory		
	General Engineering Science (English		-	: Elective Compu	lsory
	General Engineering Science (English				-
	Computational Science and Engineer				
	Technomathematics: Specialisation I	• • •			
	recimonacienacies, specialisation i	. mornauca. Liecuve comp	alsol y		

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

Course L0626: Functional Programming		
	Recitation Section (small)	
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 Programming Idioms of Functional Programming Haskell Syntax and Semantics 	
Literature	Graham Hutton, Programming in Haskell, Cambridge University Press 2007.	

Module M0834: Comp	uternetworks and Internet S	ecurity		
Courses				
Title		Тур	Hrs/wk	СР
Computer Networks and Internet Se	ecurity (L1098)	Lecture	3	5
Computer Networks and Internet Se	ecurity (L1099)	Recitation Section (small)	1	1
Module Responsible	Prof. Andreas Timm-Giel			
Admission Requirements	None			
Recommended Previous	Basics of Computer Science			
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain important an	d common Internet protocols in detail and class	ify them, in order t	o be able to analy
	and develop networked systems in further	studies and job.		
C1:11-		we also and a sector to the second fill and in the		
SKIIIS	Students are able to analyse common Internet protocols and evaluate the use of them in different domains.			
Personal Competence				
Social Competence				
Autonomy	Students can select relevant parts out of h	igh amount of professional knowledge and can i	ndependently learn	and understand it.
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Computer Scie	nce: Elective Comp	ulsory
Following Curricula	Computer Science: Core qualification: Com	npulsory		
	Data Science: Core qualification: Elective C	Compulsory		
	Electrical Engineering: Core qualification: E	Elective Compulsory		
	Engineering Science: Specialisation Mecha	tronics: Elective Compulsory		
	General Engineering Science (English prog	ram, 7 semester): Specialisation Computer Scier	nce: Elective Compu	lsory
	General Engineering Science (English prog	ram, 7 semester): Specialisation Mechatronics: E	lective Compulsory	
	Computational Science and Engineering: C	Core qualification: Compulsory		
	Technomathematics: Specialisation II. Info	rmatics: Elective Compulsory		

Course L1098: Computer Net	works and Internet Security
Тур	Lecture
Hrs/wk	3
CP	5
Workload in Hours	Independent Study Time 108, Study Time in Lecture 42
Lecturer	Prof. Andreas Timm-Giel, Prof. Dieter Gollmann, DrIng. Koojana Kuladinithi
Language	EN
Cycle	WiSe
Content	In this class an introduction to computer networks with focus on the Internet and its security is given. Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs. In the second part of the lecture an introduction to Internet security is given. This class comprises: • Application layer protocols (HTTP, FTP, DNS) • Transport layer protocols (TCP, UDP) • Network Layer (Internet Protocol, routing in the Internet) • Data link layer with media access at the example of Ethernet • Multimedia applications in the Internet • Network management • Internet security: IPSec
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	urse 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				
Гitle		Тур	Hrs/wk	СР
ntroductory Seminar Computer Sc	ence I (L2362)	Seminar	2	3
ntroductory Seminar Computer Sc	ence II (L2361)	Seminar	2	3
Module Responsible	Prof. Karl-Heinz Zimmermann			
Admission Requirements	None			
Recommended Previous	Basic knowledge of Computer Science and	Mathematics at the Bachelor's level.		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	The students are able to			
	explicate a specific topic in the field	d of Computer Science,		
	 describe complex issues, 			
	 present different views and evaluat 	e in a critical way.		
Skills	The students are able to			
	familiarize in a specific topic of Con			
	realize a literature survey on the sp			
	 elaborate a presentation and give a 			
	 sum up the presentation in 10-15 li 			
	 answer questions in the final discussion 	sion.		
Personal Competence				
Social Competence	The students are able to			
	 elaborate and introduce a topic for 	a certain audience,		
		ture of the presentation with the instructor,		
	 discuss certain aspects with the au 			
	 as the lecturer listen and respond t 			
Autonomy	The students are able to			
	 define the task in question in an au 	tonomous way,		
	 develop the necessary knowledge, 			
	use appropriate work equipment, a			
	 guided by an instructor critically ch 	eck the working status.		
Workload in Hours	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	Science: Elective Compuls	ory
Following Curricula	Computer Science: Core qualification: Cor			
	General Engineering Science (English prog	gram, 7 semester): Specialisation Computer Se	cience: Elective Compulso	ry
	Computational Science and Engineering: (Core qualification: Compulsory		

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

Course L2361: Introductory	Course L2361: Introductory Seminar Computer Science II	
Тур	Seminar	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Karl-Heinz Zimmermann	
Language	DE/EN	
Cycle	WiSe/SoSe	
Content		
Literature		

Courses				
Title		Тур	Hrs/wk	СР
ntroduction to Control Systems (L	654)	Lecture	2	4
ntroduction to Control Systems (L	655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
	Representation of signals and systems in time and frequence	cy domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence	Arter taking part successionly, students have reached the re	nowing learning results		
Knowledge				
5	Students can represent dynamic system behavior in	time and frequency domain, and	can in particular	explain properties
	first and second order systemsThey can explain the dynamics of simple control loop	as and interpret dynamic propertie	s in terms of free	NUMPCV response a
	root locus	os and interpret dynamic propertie	is in terms of net	quency response a
	 They can explain the Nyquist stability criterion and the stability criter	he stability margins derived from it	t.	
	• They can explain the role of the phase margin in ana	lysis and synthesis of control loops	5	
	• They can explain the way a PID controller affects a c	ontrol loop in terms of its frequenc	y response	
	They can explain issues arising when controllers desi	igned in continuous time domain a	re implemented	digitally
Skills				
	Students can transform models of linear dynamic sys		ain and vice vers	a
	 They can simulate and assess the behavior of system They can design PID controllers with the help of heur 			
	 They can analyze and synthesize simple control loop 		equency respons	e techniques
	They can calculate discrete-time approximations			
	implementation			
	They can use standard software tools (Matlab Contro	l Toolbox, Simulink) for carrying ou	ut these tasks	
Personal Competence				
-	Students can work in small groups to jointly solve technical	problems, and experimentally vali	idate their contro	ller designs
Autonomy	Students can obtain information from provided sources (I	ecture notes, software document	ation, experimen	t guides) and use
	when solving given problems.			
	the source group oblighter production			
		d thereby control their learning pro	paress.	
	They can assess their knowledge in weekly on-line tests and	d thereby control their learning pro	ogress.	
		d thereby control their learning pro	ogress.	
		d thereby control their learning pro	ogress.	
Workload in Hours	They can assess their knowledge in weekly on-line tests and	d thereby control their learning pro	ogress.	
		d thereby control their learning pro	ogress.	
Workload in Hours Credit points Course achievement	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6	d thereby control their learning pro	ogress.	
Credit points	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6 None	d thereby control their learning pro	ogress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	d thereby control their learning pro	ogress.	
Credit points Course achievement Examination	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	d thereby control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		ogress.	
Credit points Course achievement Examination Examination duration and	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests and Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester	r): Core qualification: Compulsory	ogress.	
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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
	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 equationsTustin 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	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title	Тур		Hrs/wk	СР
Numerical Mathematics I (L0417) Numerical Mathematics I (L0418)	Lecture	on Section (small)	2	3 3
		on section (smail)	Z	3
Module Responsible				
Admission Requirements	None			
Recommended Previous	 Mathematik I + II for Engineering Students (german or english) or 	• Analysis & Linear Alge	ebra I + II for Te	chnomathematici
Knowledge	basic MATLAB/Python knowledge			
Educational Objectives	After taking part successfully, students have reached the following learn	ing results		
Professional Competence				
Knowledge	Students are able to			
	name numerical methods for interpolation, integration, least squa	ares problems, eigenva	alue problems, n	onlinear root find
	problems and to explain their core ideas,			
	 repeat convergence statements for the numerical methods, 			
	explain aspects for the practical execution of numerical methods	with respect to comput	tational and stor	age complexitx.
Skills	Students are able to			
	a implement apply and compare purported methods using MATLAR	Duthon		
	 implement, apply and compare numerical methods using MATLAB institution the conversion polyage polyage of numerical methods with recr 		d colution algorit	thm
	 justify the convergence behaviour of numerical methods with resp select and execute a suitable solution approach for a given proble 		u solution algori	
	• select and execute a suitable solution approach for a given proble			
Personal Competence				
Social Competence	Students are able to			
	 work together in heterogeneously composed teams (i.e., teams fr 	rom difforant study pro	grams and back	around knowlodd
	explain theoretical foundations and support each other with pract			
		cal aspects regarding	the implementation	cion or algorithms
Autonomy	Students are capable			
	 to assess whether the supporting theoretical and practical excerci 	isos aro bottor solvod i	ndividually or in	atoam
	 to assess their individual progess and, if necessary, to ask question 			a leann,
	• to assess their individual progess and, if necessary, to ask question	ns 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): Specialisat	ion Computer Science:	Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester): Spe	cialisation Mechanica	I Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisat	ion Biomedical Engine	ering: Compulso	ry
	General Engineering Science (German program, 7 semester): Spec	ialisation Mechanical	Engineering, F	ocus Biomechan
	Compulsory			
	General Engineering Science (German program, 7 semester): Specialisa	tion Mechanical Engine	ering, Focus Th	eoretical Mechan
	Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Ei	ngineering, Foci	us Aircraft Syste
	Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 semester): Specialisa	tion Mechanical Engine	eering, Focus Me	ecnatronics: Elect
	Compulsory	Vertice Machinel F.		- Franking Combo
	General Engineering Science (German program, 7 semester): Specia	lisation Mechanical Er	ngineering, Foci	us Energy Syster
	Elective Compulsory	an Elective Compulsor		
	Bioprocess Engineering: Specialisation A - General Bioprocess Engineerin Computer Science: Specialisation Computational Mathematics: Elective C		у	
	Computer Science: Specialisation Computational Mathematics: Elective C		v	
	Data Science: Core qualification: Compulsory	ce. Elective compulsor	у	
	Electrical Engineering: Core qualification: Elective Compulsory			
	Engineering Science: Core qualification: Compulsory			
	Engineering Science: Core qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Core qualifi	cation: Compulsorv		
	General Engineering Science (English program, 7 semester): Specialisati		Compulsory	
	General Engineering Science (English program, 7 semester): Spec			ocus Biomechani
	Compulsory			- state in Explore
	Compulsory General Engineering Science (English program, 7 semester): Specialisati	on Mechanical Enginee	ering, Focus Mat	eriais in Engineer
		on Mechanical Enginee	ering, Focus Mat	eriais in Engineer
	General Engineering Science (English program, 7 semester): Specialisati			
	General Engineering Science (English program, 7 semester): Specialisati Sciences: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisati Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisat	tion Mechanical Engine	ering, Focus The	eoretical Mechan
	General Engineering Science (English program, 7 semester): Specialisati Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisat Engineering: Compulsory	cion Mechanical Engine on Biomedical Enginee	ering, Focus The	eoretical Mechani 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	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	urse L0418: Numerical Mathematics I		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	3		
Workload in Hours	endent Study Time 62, Study Time in Lecture 28		
Lecturer	Sabine Le Borne, Dr. Jens-Peter Zemke		
Language	ige EN		
Cycle	WiSe		
Content	ee interlocking course		
Literature	See interlocking course		

Courses						
F itle Computer Architecture (L0793)			-	/p ecture	Hrs/wk 2	СР 3
Computer Architecture (L0793)				oject-/problem-based Learning	2	2
Computer Architecture (L1864)				ecitation Section (small)	1	1
Module Responsible	Prof. Heiko Falk					
Admission Requirements	None					
Recommended Previous	Module "Computer Engineering	"				
Knowledge						
Educational Objectives	After taking part successfully,	students have re	ached the following	learning results		
Professional Competence						
Knowledge	This module presents advance	d concepts from	n the discipline of co	omputer architecture. In the	beginning, a k	proad overview ov
	processors). Next, foundationa so-called pipelining and the m know concepts for dynamic hierarchies.	ethods used for	the acceleration of	instruction execution used in	this context.	The students get
Skills	The students are able to describe the organization of processors. They know the different architectural principles and programmin models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and t analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism.					
Personal Competence						
Social Competence	Students are able to solve simi	lar problems alo	ne or in a group and	to present the results accordi	ngly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.					
Workload in Hours	Independent Study Time 110, 9	Study Time in Le	ecture 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
	No 15 % Subject	theoretical	and			
	practica	ıl work				
Examination	Written exam					
Examination duration and	90 minutes, contents of course	and 4 attestation	ons from the PBL "Co	mputer architecture"		
scale						
Assignment for the	General Engineering Science (German program	n, 7 semester): Speci	alisation Computer Science: E	lective Compu	Ilsory
Following Curricula	Computer Science: Specialisati	on Computer an	d Software Engineeri	ing: Elective Compulsory		
	Computer Science: Specialisation I. Computer and Software Engineering: Elective Compulsory					
	Aircraft Systems Engineering: Core qualification: Elective Compulsory					
	Aircraft Systems Engineering: Specialisation Avionic Systems: Elective Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory					
	Computational Science and En	gineering: Speci	alisation I. Computer	Science: Elective Compulsory	,	
	Microelectronics and Microsyst					

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 Arc	ourse 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	iko Falk		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1864: Computer Arc	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	eiko Falk		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses					
Title		Тур	Hrs/wk	СР	
Computability and Complexity The	ory (L0166)	Lecture	2	3	
Computability and Complexity The	ory (L0167)	Recitation Section (small)	2	3	
Module Responsible	Prof. Karl-Heinz Zimmermann				
Admission Requirements	None				
Recommended Previous	Discrete Algebraic Structures, Automata	Theory, Logic, and Formal Language Theory.			
Knowledge					
Educational Objectives	After taking part successfully, students I	have reached the following learning results			
Professional Competence					
Knowleage	The students known the important machine models of computability, the class of partial recursive functions, univer computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable a 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 probl	ems alone or in a group and to present the result	accordingly.		
Autonomy	Students are able to acquire new knowle	edge from newer literature and to associate the a	cquired knowledge w	ith other classes.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	60 min				
scale					
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Computer Sc	ence: Elective Comp	ulsory	
Following Curricula	Computer Science: Core qualification: Co	ompulsory			
	Data Science: Core qualification: Elective Compulsory				
		ogram, 7 semester): Specialisation Computer Scie		ulsory	
	Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory				
	Technomathematics: Specialisation II. In				

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

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

Module M0971: Opera	ating Systems				
Courses					
Title		Тур	Hrs/wk	СР	
Operating Systems (L1153)		Lecture	2	3	
Operating Systems (L1154)		Recitation Section (small)	2	3	
Module Responsible	Prof. Volker Turau				
Admission Requirements	None				
Recommended Previous					
Knowledge	Object-oriented programming, algorith	ims, and data structures			
	Procedural programming				
		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 file	e of operations s	ystems, describe th	
	process states and their transitions, and paraphrase the architectural variants of operating systems. They give exam				
	existing operating systems and explain their	architectures. The participants of the course wri	te concurrent pro	grams using thread	
conditional variables and semaphores. Students can describe the variants of realizing a file system. Stude					
	different scheduling algorithms.				
Skille	Chudanka are able to use the DOCIV likewise for sensureat preventing is a served and efficient way. They are able to judge the				
Skills Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are efficiency of a scheduling algorithm for a given scheduling task in a given environment.					
	enciency of a scheduling algorithm for a give	en schedding task in a given environment.			
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German progra	am, 7 semester): Specialisation Computer Scienc	e: Elective Comp	ulsory	
Following Curricula	Computer Science: Specialisation I. Compute	r and Software Engineering: Elective Compulsory	/		
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory				
	Computational Science and Engineering: Spe	cialisation I. Computer Science: Elective Compul	sory		
	Technomathematics: Specialisation II. Inform	atics: Elective Compulsory			

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

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

Courses						
Title			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		6 H				
Knowledge	Automata theory and					
		ning or Functional program	-			
	Object-oriented progr	ramming, algorithms, and	data structures			
Educational Objectives	After taking part successful	y, students have reached	the following learning results			
Professional Competence						
Knowledge	Students explain the phase	ses of the software life	cycle, describe the fundamental terr	minology and co	oncepts of softwa	
	engineering, and paraphras	e the principles of structu	red software development. They give ex	amples of softwa	re-engineering tas	
	of existing large-scale syst	ems. They write test ca	ses for different test strategies and de	evise specificatio	ons or models usi	
	different notations, and critique both. They explain simple design patterns and the major activities in requirements analysi					
	maintenance, and project p	anning.				
Skille	For a given task in the sof	tware life cycle students	identify the corresponding phase and	se and select an appropriate method. They		
SKIIIS	s For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. The choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and fir					
	errors at different levels. They apply and modify non-executable artifacts. They integrate components based on interfac					
specifications.					bused on meene	
	speemeatonor					
Personal Competence						
Social Competence	Students practice peer programming. They explain problems and solutions to their peer. They communicate in English.					
Autonomy	Using on-line guizzes and a	accompanying material fo	r self study, students can assess their	level of knowled	ge continuously a	
			s, they receive additional feedback.		<u> </u>	
		3	,			
Workload in Hours	Independent Study Time 12	4, Study Time in Lecture 5	6			
Credit points						
Course achievement			scription			
		rcises				
Examination						
Examination duration and	90 min					
scale						
			nester): Specialisation Computer Science	e: Elective Comp	ulsory	
Following Curricula						
			ester): Specialisation Computer Science		lsory	
	Computational Science and	Engineering: Specialisatio	n I. Computer Science: Elective Computer	sorv		

Course L0627: Software Engineering	
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	
Literature	 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) Kassem A. Saleh, Software Engineering, J. Ross Publishing 2009.

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

ourses		
tle	Typ Hrs/wk CP	
anagement Tutorial (L0882)	Typ Hrs/wk CP Recitation Section (small) 2 3	
roduction to Management (L08		
Module Responsible	Prof. Christoph Ihl	
Admission Requirements	None	
Recommended Previous	Basic Knowledge of Mathematics and Business	
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Pl and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to	anni
Skill	 explain the differences between Economics and Management and the sub-disciplines in Management and to important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entrepring projects describe and explain basic business functions as production, procurement and sourcing, supply chain manage organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectiv uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and t out an Entrepreneurship project in a team. In particular, they are able to	meur emei es a
	 analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 	
Personal Competence		
Social Competence	Students are able to	
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves to write a report on their project. 	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70	
Credit points		
Course achievement		
Examination	Subject theoretical and practical work	
Examination duration and	several written exams during the semester	
scale		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory	
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomec Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Sy Compulsory	han /stei

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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 s 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.

[255]

Tvn		
	Lecture	
Hrs/wk		
CP	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneli	
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language	DE	
Cycle	WiSe/SoSe	
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management. Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovat Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informat 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; Alcounting, 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. An Stuttgart 2005.	
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.	

Courses			
Title	Тур	Hrs/wk	СР
Lab Cyber-Physical Systems (L1740		4	6
Module Responsible	Prof. Heiko Falk		
Admission Requirements	None		
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 environment, via sense		
	actors. Due to their particular application areas, highly specialized sensors, processors and actor		
	is a large variety of different specification approaches for CPS - in contrast to classical software en	ngineering ap	proaches.
	Based on practical experiments using robot kits and computers, the basics of specification and	modelling of	CPS are taught. T
	lab introduces into the area (basic notions, characteristical properties) and their specification tec	chniques (mo	dels of computation
	hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequent	ly perform co	ntrol tasks, the la
	experiments will base on simple control applications. The experiments will use state-of-the		
	(MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with t	he environme	ent via sensors a
	actors.		
CL 11			
Skills	After successful attendance of the lab, students are able to develop simple CPS. They understand		
	CPS and its surrounding processes which stem from the fact that a CPS interacts with the environ digital processors, D/A converters and actors. The lab enables students to compare modellin		
	advantages and limitations, and to decide which technique to use for a concrete task. They will l	• • •	
	to practical problems. They obtain first experiences in hardware-related software development,		
	tools and in the area of simple control applications.	in mousery re	specification of the specifica
Personal Competence			
•	Students are able to solve similar problems alone or in a group and to present the results accordi	ngly.	
Autonomy	Students are able to acquire new knowledge from specific literature and to associate this knowledge	lge with other	classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and	Execution and documentation of all lab experiments		
scale			
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Computer Science: El	ective Compu	Ilsory
Following Curricula	Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory		
	Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Ele		-
	Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Ele	ective compu	ізогу
	Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory		
	Mechatronics: Specialisation System Design: Elective Compulsory Mechatronics: Technical Complementary Course: Elective Compulsory		

Course L1740: Lab Cyber-Physical Systems		
Тур	pject-/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 	

Module M1062: Math	ematical Statistics			
Courses				
Title		Тур	Hrs/wk	СР
Mathematical Statistics (L1339)		Lecture	3	4
Mathematical Statistics (L1340)		Recitation Section (small)	1	2
	Prof. Natalie Neumeyer			
Admission Requirements Recommended Previous	None			
Kecommended Previous Knowledge	Mathematical Stochastics			
Knowledge	Measure Theory and Stochastics			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	for construction of estimators, optimal sufficiency and completeness and thei confidence domains and test families. The	Mathematical Statistics such as the substitut unfalsified estimators, optimal tests for r application to estimation and test proble ay are able to explain them using appropriate between these concepts. They are capable duce them.	parametric prob ms, tests in nor examples.	ability distribution mal distribution a
Skills	are capable of solving them by applying eStudents are able to discover and verify for	atical Statistics with the help of the concepts established methods. urther logical connections between the conce develop and execute a suitable approach, a	pts studied in the	e course.
Personal Competence Social Competence		ms. They are capable to use mathematics as concepts according to the needs of their coo e understanding of their peers.		
Autonomy	precisely and know where to get help in s	nderstanding of complex concepts on their of olving them. istence to be able to work for longer period		
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120 minutes			
scale				
-	General Engineering Science (English program,		e: Elective Compu	llsory
Following Curricula	Technomathematics: Specialisation I. Mathemati	ics: Elective Compulsory		
Course L1339: Mathematical	[
Тур	Lecture			
Hrs/wk				
CP				
	Independent Study Time 78, Study Time in Lectu			
	Dozenten des Fachbereiches Mathematik der UH	IH		
Language				
Cycle	SoSe			
Content	 Substitution and Maximum-Likelihood met 	thods for construction of estimators		
	 Optimal unfalsified estimators 			
	Optimal tests for parametric probability d	istributions (Neymann-Pearson theory)		
	 Sufficiency and completeness and their approximately and completeness and their approximately approxi	oplication to estimation and test problems		

- Sufficiency and completeness and their application to estimation and test problems
- Tests in normal distribution (e.g. Student's test)
- Confidence domains and test families
- Literature
 V. K. Rohatgi and A. K. Ehsanes Saleh (2001). An introduction to probability and statistics. Wiley.

 L. Wasserman (2010). All of statistics : A concise course in statistical inference. Springer.

 H. Witting (1985). Mathematische Statistik: Parametrische Verfahren bei festem Stichprobenumfang. Teubner.

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

Specialization Mechanical Engineering

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

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

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

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

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

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

Module M0933: Fundamentals of Materials Science

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials Science		Lecture	2	2
	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Ma		Lecture	2	2
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics			
Kilowiedge				
Educational Objectives	After taking part successfully, students have reached the follow	ing loorning recults		
-	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence	The students have acquired a fundamental knowledge on n	notals coromics and n	olymore and can doce	riba this knowladge
Knowledge	The students have acquired a fundamental knowledge on n 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		· · · · · · · · · · · · · · · · · · ·	
chille	The shudded and ship to the second side of a second state to	a tha sha a sha a a ta a sha a ta	al and the second at large	-f Mataila
SKIIIS	The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stren			
	resistance, and to phase transformations such as solidification			
	between processing conditions and the materials microstructu		-	
	material's behavior.	ine, and energy can accou		
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 Mechanical	Engineering: Compulso	iry
Following Curricula	General Engineering Science (German program, 7 semester): S			
	General Engineering Science (German program, 7 semester): S			ing: Compulsory
	General Engineering Science (German program, 7 semester): S		, ,	
	General Engineering Science (German program, 7 semester): S	pecialisation Naval Archi	tecture: Compulsory	
	Data Science: Specialisation Materials Science: Compulsory			
	Digital Mechanical Engineering: Core qualification: Compulsory			
		pulsory		
	Energy and Environmental Engineering: Core qualification: Com General Engineering Science (English program, 7 semester): Sp		Enviromental Engineeri	na: Compulsory
	General Engineering Science (English program, 7 semester): Sp	ecialisation Energy and	-	
		ecialisation Energy and lecialisation Mechanical I	Engineering: Compulsor	
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	ecialisation Energy and ecialisation Mechanical I ecialisation Naval Archit	Engineering: Compulsor ecture: Compulsory	У
	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 Energy and l ecialisation Mechanical I ecialisation Naval Archit ecialisation Biomedical E	Engineering: Compulsor ecture: Compulsory Engineering: Compulsor	У
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	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	ecialisation Energy and ecialisation Mechanical I ecialisation Naval Archit ecialisation Biomedical E ecialisation Naval Archit	Engineering: Compulsor ecture: Compulsory Engineering: Compulsor	У
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect	ecialisation Energy and ecialisation Mechanical I ecialisation Naval Archit ecialisation Biomedical E ecialisation Naval Archit	Engineering: Compulsor ecture: Compulsory Engineering: Compulsor	У
	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 Energy and ecialisation Mechanical I ecialisation Naval Archit ecialisation Biomedical E ecialisation Naval Archit	Engineering: Compulsor ecture: Compulsory Engineering: Compulsor	У

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

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

Courses						
Title			Typ		Hrs/wk	СР
Embodiment Design and 3D-CAD (L	0268)		Typ Lecture		2	1
Mechanical Design Project I (L0695			Project-/problem-base	ed Learning	3	2
Mechanical Design Project II (L0592			Project-/problem-base		3	2
Team Project Design Methodology			Project-/problem-base		2	1
Module Responsible	Prof. Dieter Krause					
Admission Requirements	None					
Recommended Previous						
Knowledge		s of Mechanical Engineering	g Design			
-	 Mechanics 					
		s of Materials Science				
	 Production En 	igineering				
Educational Objectives	After taking part suc	cessfully, students have re	ached the following learning results			
Professional Competence			5 5			
	After passing the mo	odule, students are able to:				
	5 1.000	,				
			parts e.g. considering load situation, n	naterials an	d manufactur	ing requirements
	 describe basic 					
	 explain basics 	s methods of engineering d	esigning.			
Skills	After passing the mo	odule, students are able to:				
			I drawings and documentations e.g. us	sing 3D CAD),	
		onents based on design gui				
		alculate) used components,				
			ering design tasks systamtically and s	olution-orier	nted,	
	 apply creativi 	ty techniques in teams.				
Personal Competence						
Social Competence	After passing the module, students are able to:					
			including making and documenting d	ecisions,		
	 moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 					
	· Teneet the on	in the work group	s of the course.			
Autonomy	Students are able					
	 to estimate t 	heir level of knowledge usi	ng activating methods within the lectu	ires (e.a. wi	ith clickers)	
		neering design tasks syster		1103 (0.g. Wi	itir clickers),	
	To some engin	neering design tasks system				
Workload in Hours	Independent Study	Time 40, Study Time in Lec	ture 140			
Credit points						
Course achievement		Form	Description	dik		
	Yes None	Written elaboration	Teamprojekt Konstruktionsmethod	ЛК		
	Yes None Yes None	Written elaboration Written elaboration	Konstruktionsprojekt 1 Konstruktionsprojekt 2			
	Yes None Yes None	Written elaboration	3D-CAD-Praktikum			
Examination	Written exam	WITCH EIUDOTALIUN				
Examination duration and						
examination duration and scale	100					
	General Engineering	Science (Corman program	, 7 semester): Specialisation Mechanic	al Engineer	ring: Compute	00/
Assignment for the Following Curricula	5 5		, 7 semester): Specialisation Mechanic , 7 semester): Specialisation Biomedic	5	5 1	5
i onowing curricula			, 7 semester): Specialisation Biomedic	-		-
	5 5	ngineering: Core qualificati			chiai Liigiilee	
	-	mental Engineering: Core q				
			7 semester): Specialisation Energy an	d Environce	ental Engineer	ing: Compulsory
			7 semester): Specialisation Mechanica		-	
			7 semester): Specialisation Biomedica	-		-
		ring: Core qualification: Cor		Engineerin		
		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
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	SoSe
Content	 Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing)
Literature	 Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag. Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag. Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag. Einführung in die DIN-Normen, Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag.

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

Courses				
Title		Тур	Hrs/wk	СР
	cal Mechanics, Numerical Mechanics) (L1137)	Lecture	3	3
	cal Mechanics, Numerical Mechanics) (L1138) cal Mechanics, Numerical Mechanics) (L1139)	Recitation Section (small) Recitation Section (large)	2 1	2 1
Module Responsible		Reclation Section (large)	1	1
Admission Requirements				
	Mathematics I-III and Mechanics I-III			
Knowledge				
	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
	The students can			
	describe the axiomatic procedure used in me	echanical contexts;		
	explain important steps in model design;			
	 present technical knowledge. 			
Skills	The students can			
	explain the important elements of mathema	tical (machanical analysis and model for	mation and appl	, it to the contact
	their own problems;			y it to the context
	 apply basic methods to engineering problem 	ıc.		
	 estimate the reach and boundaries of the me 		wider problem	ets
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	ngths 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				
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical Engine	eering: Compulso	ory
Assignment for the		semester): Specialisation Biomedical Engine	eering: Compulso	
Assignment for the	General Engineering Science (German program, 7 s	semester): Specialisation Biomedical Engine semester): Specialisation Naval Architecture	eering: Compulso	
Assignment for the	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s	semester): Specialisation Biomedical Engine semester): Specialisation Naval Architecture Core Studies: Elective Compulsory	eering: Compulso e: Compulsory	bry
Assignment for the	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s Energy Systems: Technical Complementary Course	semester): Specialisation Biomedical Engine semester): Specialisation Naval Architecture Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine	eering: Compulso e: Compulsory eering: Compulso	bry
Assignment for the	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s	semester): Specialisation Biomedical Engine semester): Specialisation Naval Architecture Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture	eering: Compulso e: Compulsory eering: Compulso :: Compulsory	ry
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Assignment for the Following Curricula Course L1137: Mechanics IV	General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s 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 General Engineering: Core qualification: Comput 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	semester): Specialisation Biomedical Engine semester): Specialisation Naval Architecture Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine lsory Science: Elective Compulsory splementary Course Core Studies: Elective	eering: Compulsory ering: Compulsory :: Compulsory ering: Compulsory ering: Compulsor	ry

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).

Content

Literature

See interlocking course

See interlocking course

Course L1138: Mechanics IV Uscillations, Analytical Mechanics, Numerical Mechanics) Typ Recitation Section (small) Hrs/wk 2 Comparing Independent Study Time 32, Study Time in Lecture 28 Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Robert Seifried Content Ses Content Ses Literature See interlocking course Course L1139: Mechanics IV Uscillations, Analytical Mechanics, Numerical Mechanics) Course L1139: Mechanics IV Uscillations, Analytical Mechanics, Numerical Mechanics) Recitation Section (large) Meridation In Jourge Vorkload In Hourge Difference Course L1139: Mechanics IV Uscillations, Analytical Mechanics, Numerical Mechanics) Meridation Section (large) Recitation Section (large) Meridation In Jourge Morkload In Hourge Independent Study Time 16, Study Time in Lecture 14 Lecturer Prof. Robert Seifried Language DE Language DE Ses		
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CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Robert Seifried Language DE Content See interlocking course Literature See interlocking course Course L1139: Mechanics / Vicial Science See interlocking course Course L1139: Mechanics / Science See interlocking course Vicial Mechanics / See interlocking course See interlocking course See interlocking course See interlocking course Vicial Mechanics / Science See interlocking course See interlocking course See interlocking course See interlocking course See interlocking course Morkload in Hours Recitation Section (large) Morkload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecturer Prof. Robert Seifried Language DE	Тур	Recitation Section (small)
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Lecturer Prof. Robert Seifried Language DE Cycle SoSe Content See interlocking course Literature See interlocking course Course L1139: Mechanics IV Sec interlocking course Course L1139: Mechanics IV Sec interlocking course Vorkload in Hours Recitation Section (large) Morkload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecturer Prof. Robert Seifried Lecturer DE	CP	2
Language DE Cycle SoSe Content See interlocking course Literature See interlocking course Course L1139: Mechanics IV Uscillations, Analytical Mechanics, Numerical Mechanics) Course L1139: Mechanics IV Uscillation S, Analytical Mechanics, Numerical Mechanics) Recitation Section (large) Arrs/wk 1 I Workload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecture Prof. Robert Seifried DE DE	Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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Lecturer Prof. Robert Seifried Language DE	CP	1
Language DE	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
	Lecturer	Prof. Robert Seifried
Cycle SoSe	Language	DE
	Cycle	SoSe

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, engine	eering mechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge t	o explain the general principles of flui	id engineering a	nd physics of fluid
	Students can scientifically outline the rationale of flo	w physics using mathematical models a	and are familiar v	vith methods for t
	performance analysis and the prediciton of fluid engir	eering devices.		
Skills	Students are able to apply fluid-engineering principle			
	enables the student to carry out all necessary theor	etical calculations for the fluid dynamic	c design of engir	leering devices or
	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	or complex problems self-consistent and	l crtically analyse	results
	····			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 ser	pester): Specialisation Mechanical Engin	eering: Compulse	orv
Following Curricula	General Engineering Science (German program, 7 ser			-
	General Engineering Science (German program, 7 ser			.,
	General Engineering Science (English program, 7 sem			~v
	General Engineering Science (English program, 7 sem		÷ .	5
	General Engineering Science (English program, 7 sem	•		v
	Computational Science and Engineering: Specialisatio			3
	Mechanical Engineering: Core qualification: Compulso			
	Naval Architecture: Core qualification: Compulsory	· ,		
	Technomathematics: Specialisation III. Engineering Sc	ionso, 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	
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
Practical Course: Measurement and	-			Practical Cours	e	2	2
Measurement Technology for Mechanical Engineering (L1116)				Lecture		2	3
Measurement Technology for Mech		.18)		Recitation Sec	tion (large)	1	1
Module Responsible	Prof. Thorsten Kern						
Admission Requirements	None						
Recommended Previous	Basic knowledge of p	physics, chem	histry and electrical	engineering			
Knowledge							
Educational Objectives	After taking part suc	cessfully, stu	dents have reache	the following learning res	ults		
Professional Competence							
Knowledge	Students are able to Calibration, Static a			dmentals of the Measuren is and Systems).	nent Technolog	y (Quantities and	d Units, Uncertaiı
	They can outline the	e most impor	rtant measuring m	thods for different kinds	of quantities to	be maesured (Electrical Quantit
	Temperature, mecha	anical quantit	ies, Flow, Time, Fr	equency).			
	They can describe in	nportant met	hods of chemical A	nalysis (Gas Sensors, Spec	troscopy, Gas C	Chromatography))
Skills	Students can select	suitable mea	suring methods to	jiven problems and can us	e refering mea	surement device	s in practice.
	The students are ab	le to orally e	xplain issues in the	subject area of measurer	nent technolog	y and solution a	pproaches as we
	place the issues into						
		5					
Personal Competence							
Social Competence	Students can arrive a	at work result	ts in groups and do	cument them in a commor	report.		
Autonomy	Students are able to	familiarize th	nemselves with new	measurement technologi	es.		
Workload in Hours	Independent Study T	Time 110 Stu	idy Time in Lecture	70			
		1110, 510	lay fille in Lecture	70			
Credit points Course achievement	Compulsory Bonus	Form	r	escription			
Course achievement	Yes None		theoretical and	escription			
		practical w					
		p					
Examination	Subject theoretical a	nd practical v					
	Subject theoretical a	nd practical v	WOLK				
Examination duration and	-	and practical v	work				
Examination duration and scale	105 minutes			mostor). Specialization Me	chanical Engin	ooring: Compute	254
Examination duration and scale Assignment for the	105 minutes General Engineering	Science (Ger	rman program, 7 se	mester): Specialisation Me			
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering	Science (Ger Science (Ger	rman program, 7 se rman program, 7 se	mester): Specialisation Bio	medical Engine	eering: Compulso	bry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering General Engineering	Science (Ger Science (Ger Science (Ger	rman program, 7 se rman program, 7 se rman program, 7 se	mester): Specialisation Bio mester): Specialisation En	medical Engine	eering: Compulso	bry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering General Engineering Digital Mechanical En	Science (Ger Science (Ger Science (Ger ngineering: C	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C	mester): Specialisation Bio mester): Specialisation En ompulsory	medical Engine	eering: Compulso	bry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environn	Science (Ger Science (Ger Science (Ger ngineering: C mental Engine	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C eering: Core qualific	mester): Specialisation Bio mester): Specialisation En ompulsory ation: Compulsory	medical Engine	eering: Compulso	bry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environn Engineering Science	Science (Ger Science (Ger Science (Ger ngineering: C nental Engine : Specialisatio	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C eering: Core qualific on Mechatronics: Co	mester): Specialisation Bio mester): Specialisation En ompulsory ation: Compulsory ompulsory	medical Engine	eering: Compulso	bry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical El Energy and Environn Engineering Science Engineering Science	Science (Ger Science (Ger Science (Ger ngineering: C mental Engine : Specialisatio : Specialisatio	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C eering: Core qualific on Mechatronics: Co on Mechanical Engi	mester): Specialisation Bid mester): Specialisation En ompulsory ation: Compulsory ompulsory neering: Compulsory	medical Engine	eering: Compulso	bry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical El Energy and Environn Engineering Science Engineering Science Engineering Science	Science (Ger Science (Ger Science (Ger ngineering: C mental Engine : Specialisatic : Specialisatic : Specialisatic	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C eering: Core qualific on Mechatronics: C on Mechanical Engi on Biomedical Engi	mester): Specialisation Bid mester): Specialisation En ompulsory ation: Compulsory ompulsory neering: Compulsory neering: Elective Compulso	omedical Engine ergy and Enviro	eering: Compulso	ory ring: Compulsory
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical El Energy and Environn Engineering Science Engineering Science Engineering Science General Engineering	Science (Ger Science (Ger Science (Ger ngineering: C mental Engine : Specialisatic : Specialisatic : Specialisatic Science (Eng	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C eering: Core qualific on Mechatronics: C on Mechatronics Engi on Biomedical Engi glish program, 7 se	mester): Specialisation Bid mester): Specialisation En ompulsory ation: Compulsory ompulsory neering: Compulsory neering: Elective Compulso nester): Specialisation Ene	omedical Engine ergy and Enviro ry rgy and Enviro	eering: Compulsc omental Engineer mental Engineer	ory ring: Compulsory ing: Compulsory
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Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environn Engineering Science Engineering Science Engineering Science General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering Logistics and Mobility Mechanical Engineer	Science (Ger Science (Ger Science (Ger ngineering: C mental Engine : Specialisatio : Specialisatio : Specialisatio Science (Eng Science	rman program, 7 se rman program, 7 se rman program, 7 se Core qualification: C eering: Core qualific on Mechatronics: Co on Mechanical Engi glish program, 7 se glish program, 7 se	mester): Specialisation Bio mester): Specialisation En ompulsory ation: Compulsory meering: Compulsory meering: Compulsory meering: Elective Compulsory mester): Specialisation Ene mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Bio agement and Processes: E	ry ry rgy and Enviro chanical Engine chanical Engine chatronics: Com chanical Engine chanical Engine	mental Engineeri mental Engineeri ering: Compulso ering: Compulso ipulsory ering: Compulso ipulsory ering: Compulso ering: Elective Co	ory ring: Compulsory ing: Compulsory ry ry ry
Examination duration and scale Assignment for the	105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environn Engineering Science Engineering Science General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering Mechanical Engineer Mechatronics: Core of	Science (Ger Science (Ger Science (Ger ngineering: C mental Engine : Specialisatio : Specialisatio : Specialisatio Science (Eng Science (Eng Science (Eng Science (Eng Science (Eng y: Specialisat ring: Core qua qualification:	rman program, 7 se rman program, 7 se core qualification: C eering: Core qualific on Mechatronics: Co on Mechatronics: Co on Mechanical Engi glish program, 7 se glish	mester): Specialisation Bio mester): Specialisation En ompulsory ation: Compulsory meering: Compulsory meering: Compulsory meering: Elective Compulsory mester): Specialisation Ene mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Men mester): Specialisation Bio agement and Processes: E	ry ry rgy and Enviro chanical Engine chanical Engine charical Engine charical Engine chanical Engine medical Engine lective Compul	mental Engineer mental Engineer ering: Compulso ering: Compulso pulsory ering: Compulso ering: Compulso ering: Elective Co sory	ory ring: Compulsory ing: Compulsory ry ry ry ompulsory

Course L1119: Practical Cour	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 gaseous pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1 Versuch 2: Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

Course L1116: Measurement	: Technology for Mechanical Engineering
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Thorsten Kern, Dennis Kähler
Language	
Cycle	WiSe 1 Fundamentals
Content	1.1 Quantities and Units
	1.2 Uncertainty 1.3 Calibration
	1.4 Static and Dynamic Properties of Sensors and Systems 2 Measurement of Electrical Quantities
	2.1 Current and Voltage
	2.2 Impedance
	2.3 Amplification
	2.4 Oscilloscope 2.5 Analog-to-Digital Conversion
	2.6 Data Transmission
	3 Measurement of Nonelectric Quantities
	3.1 Temperature
	3.2 Length, Displacement, Angle 3.3 Strain, Force, Pressure
	3.4 Flow
	3.5 Time, Frequency
Literature	Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3.
	Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940.

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

Module M0865: Funda	amentals of Production and	Quality Management		
Courses				
Title		Тур	Hrs/wk	СР
Production Process Organization (L	0925)	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 h	nave reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain the content	s of the lecture of the module.		
Skills	Students are able to apply the methods	and models in the module to industrial problems	s.	
Personal Competence				
Social Competence	-			
Autonomy	-			
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 Minuten			
scale				
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Mechan	nical Engineering, Foo	us Aircraft Systems
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanica	l Engineering, Focus F	Product Developmen
	and Production: Compulsory			
	Engineering Science: Core qualification:	Compulsory		
	General Engineering Science (English pr	ogram, 7 semester): Specialisation Mechanical E	Engineering: Elective C	ompulsory
		ogram, 7 semester): Core qualification: Compuls	-	
		duction Management and Processes: Compulsor	rу	
	Logistics and Mobility: Specialisation Eng	ineering Science: Elective Compulsory		
	Mechanical Engineering: Core qualification			
	Engineering and Management - Major in	Logistics and Mobility: Specialisation Production	Management and Pro	cesses: Compulsory

Course L0925: Production Pr	ocess Organization		
Тур	Lecture		
Hrs/wk	2		
CP	}		
Workload in Hours	dependent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Hermann Lödding		
Language	EN		
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

Module M0934: Adva	nced Materials			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Materials Characterization		Lecture	2	2
Advanced Materials Design (L1091		Lecture	2	2
Advanced Materials Design (L1092		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements	None			
	Fundamentals of Materials Science (I and II)			
Knowledge				
	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	The students will be able to explain the prope	-		hnology, in particul
	metallic, ceramic, polymeric, semiconductor, i	modern composite materials (biomaterials)	and nanomaterials.	
Skills	The students will be able to select material	configurations according to the technical	needs and, if nece	ssarv, to design ne
	materials considering architectural principles			
	modern materials science, which enables ther			-
			1 5	
Personal Competence				
Social Competence	The students are able to present solutions to s	specialists and to develop ideas further.		
Autonomy	The students are able to			
	 assess their own strengths and weakne 	sses.		
	 define tasks independently. 			
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German prog	gram, 7 semester): Specialisation Mecha	anical Engineering,	Focus Biomechanic
Following Curricula			5 5,	
-	General Engineering Science (German pro	gram, 7 semester): Specialisation Mecl	nanical Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	Data Science: Specialisation Materials Science	e: Compulsory		
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical E	ngineering: Elective (Compulsory
	Mechanical Engineering: Core qualification: El			

Course L1087: Advanced Mat	terials 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. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller		
Language	DE/EN		
Cycle	SoSe		
Content			
Literature	Vorlesungsunterlagen		

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

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 comple	xe numbers, integrals, differentials			
Knowledge	Basics of electrical engineering and mechan	ical 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	principles of electric and magnetic fields.			
		tandard types of electric machines and pres res they can explain the major parameters of the			
Skills	Students are able to calculate two-dimensi this they apply the usual methods of the de	onal electric and magnetic fields in particular fi sign auf electric machines.	erromagnetic circu	uits with air gap. I	
		ance of electric machines from their given char- sual equivalent circuits and graphical methods.	acteristic data and	d selected quantiti	
Personal Competence					
Social Competence	none				
Autonomy		e electric and magnatic fields for applications. T achines from the charactersitic data and theyca			
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, revi	ew of design files			
scale					
Assignment for the	General Engineering Science (German progr	ram, 7 semester): Specialisation Electrical Engine	eering: Elective Co	mpulsory	
Following Curricula	General Engineering Science (German pro	ogram, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syster	
	Compulsory				
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic				
		rogram, 7 semester): Specialisation Mechanic			
	Compulsory				
	General Engineering Science (German prog	rogram, 7 semester): Specialisation Mechanic ram, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th		
	General Engineering Science (German progr Engineering: Elective Compulsory	ram, 7 semester): Specialisation Mechanical Eng		neoretical Mechani	
	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi		neoretical Mechani	
	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualifi	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory		neoretical Mechani	
	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualific Electrical Engineering: Core qualification: Electrical	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory ective Compulsory		neoretical Mechani	
	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualific Electrical Engineering: Core qualification: Ele Energy and Environmental Engineering: Cor	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory ective Compulsory	iromental Enginee	neoretical Mechani ring: Compulsory	
	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualific Electrical Engineering: Core qualification: El Energy and Environmental Engineering: Cor General Engineering Science (English progra	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory ective Compulsory e qualification: Compulsory	iromental Enginee neering: Elective C	neoretical Mechani ring: Compulsory	
	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualific Electrical Engineering: Core qualification: El Energy and Environmental Engineering: Cor General Engineering Science (English progra	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory ective Compulsory e qualification: Compulsory am, 7 semester): Specialisation Mechanical Engir e: Specialisation Energy Technology: Elective Cor	iromental Enginee neering: Elective C	neoretical Mechani ring: Compulsory	
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	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualific Electrical Engineering: Core qualification: El- Energy and Environmental Engineering: Cor General Engineering Science (English progra Green Technologies: Energy, Water, Climate Logistics and Mobility: Specialisation Engine Logistics and Mobility: Specialisation Traffic Logistics and Mobility: Specialisation Produc	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory ective Compulsory e qualification: Compulsory am, 7 semester): Specialisation Mechanical Engir e: Specialisation Energy Technology: Elective Cor rering Science: Elective Compulsory Planning and Systems: Elective Compulsory tion Management and Processes: Elective Comp	iromental Enginee neering: Elective C npulsory	neoretical Mechani ring: Compulsory	
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	General Engineering Science (German progr Engineering: Elective Compulsory General Engineering Science (German progr Digital Mechanical Engineering: Core qualific Electrical Engineering: Core qualification: Ele Energy and Environmental Engineering: Cor General Engineering Science (English progra Green Technologies: Energy, Water, Climate Logistics and Mobility: Specialisation Engine Logistics and Mobility: Specialisation Traffic Logistics and Mobility: Specialisation Produc Mechanical Engineering: Core qualification: Mechatronics: Core qualification: Compulsor Technomathematics: Specialisation III. Engine	ram, 7 semester): Specialisation Mechanical Eng ram, 7 semester): Specialisation Energy and Envi cation: Compulsory ective Compulsory e qualification: Compulsory am, 7 semester): Specialisation Mechanical Engir e: Specialisation Energy Technology: Elective Cor rering Science: Elective Compulsory Planning and Systems: Elective Compulsory tion Management and Processes: Elective Comp Elective Compulsory Y	iromental Enginee neering: Elective C npulsory ulsory	neoretical Mechani ring: Compulsory ompulsory	

Course L0293: Electrical Mac	hines and Actuators
Тур	Lecture
Hrs/wk	3
CP	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

Focus Biomechanics

	iomechanics get in addition to their core enginee ables them to understand operational planning a	as well as research and development in	this highly inter	rdisciplinary area
Module M0597: Adva	nced Mechanical Engineering Desig	ın		
Courses				
Title		Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (L0264)	Lecture	2	2
Advanced Mechanical Engineering		Recitation Section (large)	2	1
Advanced Mechanical Engineering Advanced Mechanical Engineering		Lecture Recitation Section (large)	2	2 1
Module Responsible		Rectation Section (large)	-	*
Admission Requirements				
Recommended Previous				
Knowledge	Fundamentals of Mechanical Engineering Des	sign		
	Mechanics Fundamentals of Materials Science			
	Production Engineering			
	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	After passing the module, students are able to:			
Knowledge				
	explain complex working principles and funct			
	 explain requirements, selection criteria, appl indicate the background of dimensioning calc 		r complex machi	ne elements,
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of cove	ered machine elements,		
	• transfer knowledge learned in the module to	new requirements and tasks (problem sol	ving skills),	
	 recognize the content of technical drawings a 	and schematic sketches,		
	 evaluate complex designs, technically. 			
Personal Competence				
Social Competence		action in the last we compared by activation	a mathada	
	 Students are able to discuss technical inform 	lation in the lecture supported by activatin	g methods.	
Autonomy	 Students are able to independently deepen t 	heir acquired knowledge in exercises		
	 Students are able to independently deependently Students are able to acquire additional know 		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		***		
Course achievement				
Examination	Written exam			
Examination duration and	120			
scale				
Assignment for the	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical Engin	eering: Compulse	ory
Following Curricula	General Engineering Science (German program,	7 semester): Specialisation Mechanica	l Engineering, F	
	Compulsory			ocus Biomechani
	General Engineering Science (German program,	7 semester): Specialisation Mechanical I	Engineering, Foc	
	Compulsory			us Energy Systen
				us Energy Systen
	Compulsory General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foo	us Energy Systen cus Aircraft Systen
	Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory	7 semester): Specialisation Mechanical 1, 7 semester): Specialisation Mechanic	Engineering, Foo al Engineering,	us Energy Systen tus Aircraft Systen Focus Materials
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	Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, Compulsory	7 semester): Specialisation Mechanical 1, 7 semester): Specialisation Mechanica 1, 7 semester): Specialisation Mechanica	Engineering, Foo al Engineering, I Engineering, I	us Energy Systen cus Aircraft Systen Focus Materials Focus Mechatroni
	Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7	7 semester): Specialisation Mechanical 1, 7 semester): Specialisation Mechanica 1, 7 semester): Specialisation Mechanica	Engineering, Foo al Engineering, I Engineering, I	us Energy Systen cus Aircraft Systen Focus Materials Focus Mechatroni
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	Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, 7 Engineering: Compulsory Energy Systems: Technical Complementary Course Engineering Science: Specialisation Mechanical Eng General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, Compulsory General Engineering Science (English program, Engineering: Compulsory General Engineering Science (English program, 7 Engineering: Compulsory General Engineering Science (English program, 7 Engineering: Compulsory General Engineering Science (English program, 7 Engineering: Compulsory	7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanica semester): Specialisation Mechanical Enginesis Specialisation Mechanical Engine Core Studies: Elective Compulsory gineering: Compulsory emester): Specialisation Mechanical Engine 7 semester): Specialisation Mechanical Engine 7 sem	Engineering, Foc al Engineering, I I Engineering, Focus F neering, Focus Th eering: Compulso Engineering, Foc Engineering, Foc	us Energy System cus Aircraft System Focus Materials Focus Mechatronic Product Developme neoretical Mechanic ry focus Biomechanic us Energy System cus Aircraft System
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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:
	 randamentals of the following machine elements. Linear rolling bearings
	Axes & shafts
	Seals
	 Clutches & brakes
	Belt & chain drives
	 Gear drives
	• Epicyclic gears
	Crank drives
	 Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	 Calculation methods of the following machine elements: Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	• Crank gears
	• Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	• Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

 Course Lo265: Advanced W=-incla Engineering Design II

 Course Lo265: Advanced W=-incla Engineering Design II

 Recitation Section (large)

 Recitation Section (large)

 Image: Section Section (large)

 Image: Section Section Section (large)

 Image: Section Section

Түр	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
Content	
	Lecture
	Fundamentals of the following machine elements:
	 Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank drives
	Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	Epicyclic gears
	Crank gears
	Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	 Dubbel, Taschenbuch für den Maschinenbau, Glote, Kn., Feldhäsen, J.(Hisg.), 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.
	 Konstruktionsteine, Fain, G., beitz, W., Springer-verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	 Maschinenelemente - 2, schlecht, B., Pearson verlag, aktuelle Aunage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuel
	 Maschinenerenner - 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
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 musculoskeleta	al 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 comm	10n 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 profe	ssional level.	
Autonomy	The students are able to access anatomical knowledge by themselves, can participate in converse	ations on the	topic and acqu
	the relevant knowledge themselves.		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Credit points			
Course achievement			
	Written exam		
Examination duration and			
scale			
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering	a: Compulsorv	
Following Curricula			
	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 Eng	ineering, Focu	us Biomechani
	Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering		
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering	: Compulsory	
	Mechanical Engineering: Specialisation Biomechanics: Compulsory	24	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsor	-	
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compu- Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compu-		
	prometical Engineering. Specialisation Artificial Organs and Regenerative Medicine: Elective Comp	21301 y	
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory		

se L0384: Introduction t		
	Lecture	
Hrs/wk		
СР	3	
	Independent Study Time 62, Study Time in Lecture 28	
	Prof. Tobias Lange	
Language		
Cycle		
Content	General Anatomy	
	1 st week: The Eucaryote Cell	
	2 nd week: The Tissues	
	3 rd week: Cell Cycle, Basics in Development	
	4 th week: Musculoskeletal System	
	5 th week: Cardiovascular System	
	6 th week: Respiratory System	
	7 th week: Genito-urinary System	
	8 th week: Immune system	
	9 th week: Digestive System I	
	10 th week: Digestive System II	
	11 th week: Endocrine System	
	12 th week: Nervous System	
	13 th week: Exam	
Literature	Adolf Faller/Michael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016	

Courses			
Fitle		Тур	Hrs/wk CP
ntroduction to Radiology and Radi	ation Therapy (L0383)	Lecture	2 3
Module Responsible	Prof. Ulrich Carl		
Admission Requirements			
Recommended Previous Knowledge	None		
-	After taking part successfully, students I	have reached the following learning results	
Professional Competence			
Knowledge			
	The students can distinguish different ty	pes of currently used equipment with respect	to its use in radiation therapy.
	The students can explain treatment plan	ns used in radiation therapy in interdisciplinary	contexts (e.g. surgery, internal medicine
	The students can describe the patie	ents' passage from their initial admittance	e through to follow-up care.
	Diagnostics		
	The students can illustrate the technics	al base concepts of projection radiography, in	cluding angiography and mammography
	well as sectional imaging techniques (C		ciuding anglography and manimography
	The students can explain the diagnostic techniques.	c as well as therapeutic use of imaging technic	ques, as well as the technical basis for t
	The students can choose the right treat	ment method depending on the patient's clinic	al history and needs.
	The student can explain the influence of	f technical errors on the imaging techniques.	
	The student can draw the right conclusion	ons based on the images' diagnostic findings o	r the error protocol
Skills	Therapy The students can distinguish curative ar	nd palliative situations and motivate why they	came to that conclusion.
	The students can develop adequate the	rapy concepts and relate it to the radiation bio	logical 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).		
		idual psychosocial service should look like (e.g. follow-up treatment, sports, social
	Diagnostics		
	The students can suggest solutions for r	epairs of imaging instrumentation after having	done error analyses
	The students can classify results of im anatomy, pathology and pathophysiolog	aging techniques according to different grou Jy.	os of diseases based on their knowledg
Personal Competence			
Social Competence		ial situation of tumor patients and interact with al, often fear-dominated behavior of sick pe	
	measures and can meet them appropria		spie caused by diagnostic and therape
Autonomy	The students can apply their new knowle	edge and skills to a concrete therapy case.	
Autonomy	The students can introduce younger stu		
	The students are able to access anaton	nical knowledge by themselves, can participat	e competently in conversations on the t
	and acquire the relevant knowledge the		
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28	
Credit points			
Course achievement	None		
Examination			
Examination duration and scale	90 minutes		
	General Engineering Science (German p	rogram, 7 semester): Specialisation Biomedica	l Engineering: Compulsory
Following Curricula	General Engineering Science (Germar	n program, 7 semester): Specialisation Me	hanical Engineering, Focus Biomecha
	Compulsory		
	Data Science: Specialisation Medicine: C Electrical Engineering: Specialisation Me		
	Engineering Science: Specialisation Bior		
		program, 7 semester): Specialisation Mee	hanical Engineering, Focus Biomecha
	Compulsory General Engineering Science (English pr	ogram, 7 semester): Specialisation Biomedical	Engineering: Compulsory
		ogram, 7 semester): Specialisation Biomedical	
	Mechanical Engineering: Specialisation I		
	Biomedical Engineering: Specialisation N		

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

	co Radiology and Radiation Therapy Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Carl, Prof. Thomas Vestring
Language	
Cycle	SoSe The students will be given an understanding of the technological possibilities in the field of medical imaging
Content	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

	als and Systems	
Courses		
Title	Typ Hrs/wk	СР
Signals and Systems (L0432)	Lecture 3	4
Signals and Systems (L0433)	Recitation Section (small) 2	2
Module Responsible	Prof. Gerhard Bauch	
Admission Requirements	None	
Recommended Previous	Mathematics 1-3	
Knowledge		
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by 1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Lapla	
	but not required.	
	but not required.	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using method	s of signal and sys
	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time sign	als and systems. T
	can describe and analyse deterministic signals and systems mathematically in both time and image dom	
	understand the effects in time domain and image domain which are caused by the transition of a conti	nuous-time signal
	discrete-time signal.	
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using	-
	system theory. They can analyse and design basic systems regarding important properties such as	
D	response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time	and frequency don
Personal Competence		
	The students can jointly solve specific problems.	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can	control their leve
	knowledge during the lecture period by solving tutorial problems, software tools, clicker system.	
	Independent Study Time 110, Study Time in Lecture 70	
Credit points		
Course achievement		
	Written exam	
Examination duration and scale		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory	
Following Curricula		
· ····································	Data Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulso	ory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Comput	sory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	Focus Biomecha
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Energy Syste
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Aircraft Syst
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus N	laterials in Enginee
	Sciences: Compulsory	Feerie Mechatra
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory	, FOCUS MECHALIOI
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus	Theoretical Mechar
	Engineering: Compulsory	Theoretical Preciliar
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor	v
	General Engineering Science (English program, 7 semester): Specialisation Freese Engineering: Computer General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Computer	-
	Computational Science and Engineering: Core qualification: Compulsory	-
	Mechatronics: Core qualification: Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
Course L0432: Signals and S	ystems	
Түр	Lecture	

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 function
 - Crosscorrelation 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	

Module M1333: BIO I:	Implants and Fracture Healing					
Courses						
Title		Тур	Hrs/wk	СР		
Implants and Fracture Healing (L0376)		Lecture	2	3		
Module Responsible	Prof. Michael Morlock					
Admission Requirements	None					
Recommended Previous	It is recommended to participate in "Introduction into Anatomie" before attending "Implants and Fracture Healing".					
Knowledge						
Educational Objectives	After taking part successfully, students have reached the following learning results					
Professional Competence						
Knowledge	whedge The students can describe the different ways how bones heal, and the requirements for their existence.					
	The students can name different treatments for the spine and hollow bones under given fracture morphologies.					
Skills	The students can determine the forces acting within the human body under quasi-static situations under specific assumptions.					
Personal Competence						
•	The students can, in groups, solve basic numerical modeling tasks for the calculation 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 Mec	hanical Engineering, F	ocus Biomechanie		
Following Curricula	Compulsory					
	General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory					
	Engineering Science: Specialisation Biomedical Engineering: Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory					
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics					
	Compulsory					
	Mechanical Engineering: Specialisation Biomechanics: Compulsory					
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory					
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory					
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory					
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory					
	Orientation Studies: Core qualification: Elective Con					
	Technomathematics: Specialisation III. Engineering	Science: Elective Compulsory				

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

Courses				
Title		Тур	Hrs/wk	СР
Introduction 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 h	ave 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 D	NA and proteins;		
CI. 11				
SKIIIS	The students can			
	 recognize the importance of molection 	cular parameters for the course of a disease;		
	describe selected molecular-diagn	ostic procedures;		
	 explain the relevance of these pro- 	cedures for some diseases		
Personal Competence				
-	The students can participate in discussion	ns in research and medicine on a technical leve	el.	
Autonomy	The students can develop understanding	of topics from the course, using technical litera	ature, by themselves.	
Workload in Hours	Independent Study Time 62, Study Time	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 pr	ogram, 7 semester): Specialisation Biomedical	Engineering: Compulsory	
Following Curricula	General Engineering Science (German	program, 7 semester): Specialisation Mech	nanical Engineering, Focus	s Biomechani
	Compulsory			
	Data Science: Specialisation Medicine: Co	ompulsory		
	Electrical Engineering: Specialisation Med	dical Technology: Elective Compulsory		
	Engineering Science: Specialisation Biom	edical Engineering: Compulsory		
	General Engineering Science (English pro	gram, 7 semester): Specialisation Biomedical B	Engineering: Compulsory	
	General Engineering Science (English	program, 7 semester): Specialisation Mech	nanical Engineering, Focus	s Biomechani
	Compulsory			
	Mechanical Engineering: Specialisation B	iomechanics: Compulsory		
	Biomedical Engineering: Specialisation M	anagement and Business Administration: Elect	ive Compulsory	
	Biomedical Engineering: Specialisation A	rtificial Organs and Regenerative Medicine: Ele	ctive Compulsory	
	Biomedical Engineering: Specialisation M	edical Technology and Control Theory: Elective	e Compulsory	
	Biomedical Engineering: Specialisation In	nplants and Endoprostheses: Elective Compuls	ory	
	Technomathematics: Specialisation III. Er			

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	Ту	'p	Hrs/wk	СР
ntroduction to Control Systems (L		cture	2	4
ntroduction to Control Systems (L0	0655) Re	citation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements				
	Representation of signals and systems in time and frequency domai	n, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following I	earning results		
Professional Competence				
Knowledge				
	Students can represent dynamic system behavior in time and	d frequency domain, and	can in particular	explain properties
	first and second order systems They can explain the dynamics of simple control loops and in 	terpret dynamic propertie	s in terms of free	nuency response a
	root locus	terpret dynamic propertie	is in terms of net	quency response a
	They can explain the Nyquist stability criterion and the stability	ty margins derived from it	t.	
	• They can explain the role of the phase margin in analysis and	synthesis of control loops	5	
	They can explain the way a PID controller affects a control log	op in terms of its frequenc	y response	
	They can explain issues arising when controllers designed in	continuous time domain a	re implemented	digitally
Skills				
	Students can transform models of linear dynamic systems from		ain and vice vers	a
	 They can simulate and assess the behavior of systems and co They can design PID controllers with the help of heuristic (Zie 			
	 They can analyze and synthesize simple control loops with the 	5	equency respons	e techniques
	 They can calculate discrete-time approximations of cont 			
	implementation			
	They can use standard software tools (Matlab Control Toolbox	κ, Simulink) for carrying οι	ut these tasks	
Personal Competence				
	Students can work in small groups to jointly solve technical problem	s, and experimentally vali	date their contro	ller designs
Autonomy				
	when solving given problems.			-
		control their learning pro	arocc	
	They can assess their knowledge in weekly on-line tests and thereby	y control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and thereby	y control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and thereby	y control their learning pro	ogress.	
		y control their learning pro	ogress.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	y control their learning pro	ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56 6	y control their learning pro	ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 56 6 None	y control their learning pro	ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	y control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min	y control their learning pro	ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min	y control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of		ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory	qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect	qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory	qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory	qualification: Compulsory cive Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory	qualification: Compulsory cive Compulsory ory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsor	qualification: Compulsory cive Compulsory ory lisation Electrical Engineer	ring: Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compuls General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory cive Compulsory ory lisation Electrical Engineer lisation Civil Engineering:	ring: Compulsory Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory cive Compulsory ory lisation Electrical Engineer lisation Civil Engineering: f lisation Bioprocess Engine	ring: Compulsory Compulsory ering: Compulsor	ŷ
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energly and Environmental Engineering: Core qualification: Specia General Engineering Science (English program, 7 semester): Specia	qualification: Compulsory cive Compulsory lisation Electrical Engineer lisation Civil Engineering: lisation Bioprocess Engine lisation Energy and Enviro lisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory	ry ing: Compulsory
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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 plots Root locus design of PID controllers
	Frequency response techniques
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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 equationsTustin 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	to Control Systems
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
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 (germar	or onglich) or Applycic & Lincor Alg	obro L I II for To	chnomathomatici
Knowledge	 Mathematik I + II for Engineering Students (german basic MATLAB/Python knowledge 	or english) or Analysis & Linear Alg		chnomathematici
	Basic MATEAB/Fython knowledge			
Educational Objectives	After taking part successfully, students have reached the	ollowing learning results		
Professional Competence				
Knowledge	Students are able to			
	 name numerical methods for interpolation, integra 	ion, least squares problems, eigenv	alue problems, n	onlinear root find
	problems and to explain their core ideas,		•	
	• repeat convergence statements for the numerical r	nethods,		
	explain aspects for the practical execution of nume	rical methods with respect to compu	tational and stor	age complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical methods institute the conversions behaviour of numerical methods 		d colution class	the me
	 justify the convergence behaviour of numerical me select and execute a suitable solution approach for 		id solution algori	unm,
	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 pr	ourams and back	around knowled
	explain theoretical foundations and support each of			
		ner with practical aspects regarding	the implementa	cion or argonania
Autonomy	Students are capable			
	 to assess whether the supporting theoretical and p 	actical excercises are better solved	individually or in	a team
	 to assess their individual progess and, if necessary, 			a team,
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				
	General Engineering Science (German program, 7 semest			
Following Curricula	General Engineering Science (German program, 7 s	emester): Specialisation Mechanica	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semest			
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical	Engineering, F	ocus Biomechan
	Compulsory	or), Specialization Machanical Engin	ooring Focus Th	
	General Engineering Science (German program, 7 semest	en, specialisation Mechanical Endin	eening, rocus Th	oprotical Mash-
	Engineering: Compulsory	5	-	eoretical Mechan
	Engineering: Compulsory General Engineering Science (German program 7 sem			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem Engineering: Elective Compulsory	ester): Specialisation Mechanical E	Engineering, Foc	us Aircraft Syste
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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	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			
Instants	Title	Тур Н	lrs/wk	СР
Media Responsible Prof. Helse fail: Amaission Requirements Recommended Previous Back Donseloge in electrical engineering Professional Competence Marchaeting and accessfully, students have reached the following barning results Professional Competence It is module deals with the formations of the functionality of computing systems. It covers the layers from the assembly- organeming deam to gales. The module lackades the following backs. It is induction It introduction It is inducted easis with the formations of the functionality of computing systems, combinational networks is sequential lagier; High equations, submachia, multiplication and division It is inducted as a single comparison of the CPU, principles of passing data, point-to-pointing It is inducted as a single comparison of the CPU, principles of passing data, point-to-pointing users It is inducted as a single comparison from the achievit's perspective. Lis, may idontly the interval attraction bugst composition of computing systems. The students can asaly its how playly specific and inducial computers on tabult back conclusion of acai ad single comparison. The students are able to biddly the interval back the executed back the interval back the dividual computer systems. The students matching are systems's performance and to propose feasible options. Advisory Students are able to back the dividual comparison of a solubard comparison. Advisor and table to solve similar problems ali	Computer Engineering (L0321)			
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Konselog This module does with the foundations of the functionality opacers. It excess the layers from the assembly in product includes the following topics: in introduction - Combinational logic: Gates, Boolean Austeria, Boolean functions, hardware synthesis, combinational networks. is expendite of the information of the module includes the following topics: - Section of the information of the module includes the following topics: is expendite of the information of the module includes the following opacing of the information of the module includes the following opacing of the information of the module includes the information of the informatio	Educational Objectives	After taking part successfully, students have reached the following learning results		
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Combinational logic: Gates, Boolean algobra. Boolean functions, hardware synthesis, combinational networks	Knowledge		layers from	the assembly-le
inday's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comp system and the software executed on it, in particular, twps will understand the consequences that the execution of software on the hardware centric 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 Course achieverentic Gemotary tensor Bearinstation Write oxam Examination Yrite oxam Examination On minutes, contents of course and labs scale Scale Pollowing Curricutal General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanico Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanico Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechanic Engineering: Compulsory <	Skills	Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinate 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, pipelin Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point co	ning onnections, b ernal structur	usses re and the phys
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 Cereitto points Exemination Kereineme Computery Team Term Description Exercises Examination duration and Do Ninutes, contents of course and labs General Engineering Science (German program, 7 semester): Specialisation Computer Science: 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 Mechatron 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 Material Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechat Engineerin		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 system and the software executed on it. In particular, they shall understand the consequences that on the hardware-centric abstraction layers from the assembly language down to gates. This way, th	between a t the executi hey will be e	physical comp on of software nabled to evalu
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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	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. 		

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
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 "Implantate und Frakturheilung" before attending "Experimentelle Methoden".			
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	for their existence.	
	The students can name different treatme	ents for the spine and hollow bones under giv	ven fracture morphologies	5.
	The students can describe different mea	surement techniques for forces and moveme	ents, and choose the adec	uate technique fo
	given task.			
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				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani			
Following Curricula	Compulsory			
	General Engineering Science (German pr	rogram, 7 semester): Specialisation Biomedic	al Engineering: Compulso	ory
	Engineering Science: Specialisation Biom	nedical Engineering: Elective Compulsory		
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus				ocus Biomechani
	Compulsory			
		ogram, 7 semester): Specialisation Biomedica		-
		ogram, 7 semester): Specialisation Biomedica	al Engineering: Elective C	ompulsory
	Mechanical Engineering: Specialisation B Technomathematics: Specialisation III. E			

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	

Courses				
Title		Тур	Hrs/wk	СР
Introduction to Physiology (L0385)		Lecture	2	3
Module Responsible	Dr. Roger Zimmermann			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
Educational Objectives	After taking part successfully, student	s 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	oloav.
Skills		of basic bodily functions (sensory, transmission	n and processing of inform	mation, developme
	of forces and vital functions) and relat	e them to similar technical systems.		
Personal Competence				
Social Competence		in research and medicine on a technical level.		
	The students can find solutions to prol	blems in the field of physiology, both analytical	and metrological.	
Autonomy	The students can derive answers to	questions arising in the course and other phys	siological areas, using te	chnical literature,
	themselves.			
Workload in Hours	Independent Study Time 62, Study Tin	no in Locturo 28		
Credit points	3			
Course achievement				
Examination				
Examination duration and	60 minutes			
scale	oo minutes			
Assignment for the	General Engineering Science (German	program, 7 semester): Specialisation Biomedic	al Engineering: Compulse	orv
Following Curricula		an program, 7 semester): Specialisation Dismeale		-
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	Data Science: Specialisation Medicine:	Compulsory		
		Medical Technology: Elective Compulsory		
	Engineering Science: Specialisation Bi	omedical Engineering: Elective Compulsory		
	General Engineering Science (Englis	sh program, 7 semester): Specialisation Me	chanical Engineering, F	ocus Biomechan
	Compulsory			
	General Engineering Science (English	program, 7 semester): Specialisation Biomedica	al Engineering: Compulso	ry
	General Engineering Science (English	program, 7 semester): Specialisation Biomedica	al Engineering: Elective C	ompulsory
	Mechanical Engineering: Specialisation	n Biomechanics: Compulsory		
	Biomedical Engineering: Specialisation	n Medical Technology and Control Theory: Electi	ve Compulsory	
		Management and Business Administration: Ele		
		n Artificial Organs and Regenerative Medicine: E		
		n Implants and Endoprostheses: Elective Compu . Engineering Science: Elective Compulsory	llsory	

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

Courses	
Fitle	Typ Hrs/wk CP
Management Tutorial (L0882)	Recitation Section (small) 2 3
ntroduction to Management (L088)	10) Lecture 3 3
Module Responsible	Prof. Christoph Ihl
Admission Requirements	None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planni and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
Skills	 explain the differences between Economics and Management and the sub-disciplines in Management and to narimportant definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneu projects describe and explain basic business functions as production, procurement and sourcing, supply chain management organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives a uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to ca out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk
Personal Competence	 analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems
	Students are able to
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselves to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	
Course achievement	
	several written exams during the semester
-	General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: 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
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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 s 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.

[301]

	Lecture		
Hrs/wk			
CP	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneli		
	rstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	E		
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, Innovat Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informat 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; Alance-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. A Stuttgart 2005.		
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.		
	Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.		

Focus Energy Systems

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

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	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, Bo	oolean functions, hardware synthesis, co	ombinational net	works
	Sequential logic: Flip-flops, automata, systemat	ic hardware design		
	 Technological foundations 			
	Computer arithmetic: Integer addition, subtract	ion, multiplication and division		
	Basics of computer architecture: Programming		pipelining	
	Memories: Memory hierarchies, SRAM, DRAM, c			
	Input/output: I/O from the perspective of the CP	U, principles of passing data, point-to-p	oint connections,	busses
Skills The students perceive computer systems from the architect's perspective, i.e., they identify the internal structu composition of computer systems. The students can analyze, how highly specific and individual computers can collection of few and simple components. They are able to distinguish between and to explain the different a today's computing systems - from gates and circuits up to complete processors.			n be built based or	
	After successful completion of the module, the stude system and the software executed on it. In particular, on the hardware-centric abstraction layers from the a the impact that these low abstraction levels have on a	they shall understand the consequence ssembly language down to gates. This	es that the exect way, they will be	ution of software h enabled to evalua
Personal Competence				
Social Competence	Students are able to solve similar problems alone or in	a group and to present the results acc	ordingly.	
A				
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 5	6		
Credit points				
Course achievement		scription		
	Yes 10 % Excercises			
	Written exam			
	90 minutes, contents of course and labs			
scale			<u> </u>	
Assignment for the			1 3	
Following Curricula				ory
	General Engineering Science (German program, 7 sem General Engineering Science (German program, 7 sem	•		,
	General Engineering Science (German program, 7 sen		5 1 .	
	General Engineering Science (German program, 7 sen	-		-
	General Engineering Science (German program, 7 ser		-	ing. compusory
	General Engineering Science (German program, 7			Focus Mechatroni
	Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Mechanica	l Engineering, F	ocus Biomechani
	Compulsory			
	General Engineering Science (German program, 7 Engineering: Compulsory	semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syster
	General Engineering Science (German program, 5 Engineering Sciences: Compulsory	7 semester): Specialisation Mechanic	al Engineering,	Focus Materials
			Leaving Feeling Th	
	General Engineering Science (German program, 7 sen Engineering: Compulsory	nester): Specialisation Mechanical Engir	ieening, Focus Tr	ieoretical Mechani
			-	
	Engineering: Compulsory General Engineering Science (German program, 7 set	mester): Specialisation Mechanical Eng	ineering, Focus F	roduct Developm

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 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 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

	als and Systems	
Courses		
Title	Typ Hrs/wk	СР
Signals and Systems (L0432)	Lecture 3	4
Signals and Systems (L0433)	Recitation Section (small) 2	2
Module Responsible	Prof. Gerhard Bauch	
Admission Requirements	None	
Recommended Previous	Mathematics 1-3	
Knowledge		
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by 1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Lapla	
	but not required.	
	but not required.	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using method	s of signal and sys
	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time sign	als and systems. T
	can describe and analyse deterministic signals and systems mathematically in both time and image dom	
	understand the effects in time domain and image domain which are caused by the transition of a conti	nuous-time signal
	discrete-time signal.	
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using	-
	system theory. They can analyse and design basic systems regarding important properties such as	
D	response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time	and frequency don
Personal Competence		
	The students can jointly solve specific problems.	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can	control their leve
	knowledge during the lecture period by solving tutorial problems, software tools, clicker system.	
	Independent Study Time 110, Study Time in Lecture 70	
Credit points		
Course achievement		
	Written exam	
Examination duration and scale		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory	
Following Curricula		
· ····································	Data Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulse	ory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Comput	sory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	Focus Biomecha
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Energy Syste
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Aircraft Syst
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus N	laterials in Enginee
	Sciences: Compulsory	Feerie Mechatra
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory	, FOCUS MECHALIOI
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus	Theoretical Mechar
	Engineering: Compulsory	Theoretical Preciliar
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor	v
	General Engineering Science (English program, 7 semester): Specialisation Freese Engineering: Computer General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Computer	-
	Computational Science and Engineering: Core qualification: Compulsory	-
	Mechatronics: Core qualification: Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
Course L0432: Signals and S	ystems	
Түр	Lecture	

Тур	ecture	
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 function
 - Crosscorrelation function
 - Orthogonal signals
 - Applications of correlation
- Linear time-invariant (LTI) systems
 - Linearity
 - Time-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 S	Course L0433: Signals and Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Gerhard Bauch	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0655: Comp	utational Fluid Dynamics I			
Courses				
Title		Typ	Hrs/wk	СР
Computational Fluid Dynamics I (LC	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 calculus ar 	nd series expansions		
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence		5 5		
-	The students are able to list the basic numerics of part	ial differential equations.		
	· · · · · · · · · · · · · · · · · · ·			
Skills	The students are able develop appropriate numerical i	ntegration in space and time for the go	overning partial d	ifferential equation
	They can code computational algorithms in a structure			
	, , ,			
Personal Competence				
Social Competence	The students can arrive at work results in groups and o	document them.		
Autonomy	The students can independently analyse approaches to	o solving specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program, 7 sem	nester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechanio
	Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
	Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Elective Compulsory			
	General Engineering Science (German program, 7 sem			
	General Engineering Science (German program, 7 sem		omental Enginee	ring: Compulsory
	Energy Systems: Technical Complementary Course Co			
	General Engineering Science (English program, 7 seme		-	
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical l	ngineering, Foc	us Energy System
	Elective Compulsory	octor). Spacialization Naval Architecture	Compulson	
	General Engineering Science (English program, 7 seme			us Aircraft System
	General Engineering Science (English program, 7 s Engineering: Elective Compulsory		Ligineering, FOC	us Alleralt Syster
	Mechanical Engineering: Specialisation Energy System	s: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft System			
		5 · · · 5 · · · · · · · · · · · · · · ·		
	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	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Thomas Rung	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Fitle		Typ	Hrs/wk	СР
Advanced Mechanical Engineering I	Design II (10264)	Typ Lecture	2	2
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	Prof. Dieter Krause			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Fundamentals of Mechanical Engineering 	g Design		
2	Mechanics			
	 Fundamentals of Materials Science 			
	Production Engineering			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence	Arter taking pare successionly, students have re	active the following learning results		
-	After passing the module, students are able to:			
	 explain complex working principles and 	functions of machine elements and of basic	elements of fluidics	, ,
	 explain requirements, selection criteria, 		es of complex machi	ine elements,
	 indicate the background of dimensioning 	g calculations.		
Skills	Skills After passing the module, students are able to:			
	 accomplish dimensioning calculations of 	covered machine elements.		
		le to new requirements and tasks (problem	solving skills)	
	 recognize the content of technical drawi 		,	
	 evaluate complex designs, technically. 	ngo ana seremane sketenes,		
Personal Competence				
Social Competence	- Chudente are able to discuss technical in	formation in the lasture supported by activ	ating matheda	
	 Students are able to discuss technical in 	formation in the lecture supported by activ	ating methods.	
Autonomy				
	 Students are able to independently deep 			
	 Students are able to acquire additional 	knowledge and to recapitulate poorly und	lerstood content e.g	 by using the vio
	recordings of the lectures.			
Workload in Hours	Independent Study Time 68, Study Time in Lec	ture 112		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory			
Following Curricula	General Engineering Science (German progra	am, 7 semester): Specialisation Mechanic	al Engineering, Foo	us Energy System
	Compulsory			
	Energy and Environmental Engineering: Core q	ualification: Elective Compulsory		
	Energy Systems: Technical Complementary Co	urse Core Studies: Elective Compulsory		
	Engineering Science: Specialisation Mechanical	l Engineering: Compulsory		
	General Engineering Science (English program,		gineering: Compulso	ory
	General Engineering Science (English program			
	Compulsory	, , ,	, 100	
	Mechanical Engineering: Core qualification: Cor	mpulsory		

Course L0264: Advanced Med	chanical Engineering Design II			
	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 Coloulations of hydrostatic systems (fluiding)			
	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

Course 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)
	• Calculations of hydrostatic systems (nutrics)
Literature	
	 Dubbel, Taschenbuch f ür den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	 Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	 Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	 Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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

Courses				
Fitle	ту	a	Hrs/wk	СР
ntroduction to Control Systems (L0		cture	2	4
ntroduction to Control Systems (L0	655) Re	citation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and frequency domain	in, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	earning results		
Professional Competence				
Knowledge	Students can represent dynamic system behavior in time an	d frequency domain, and o	an in particular	explain properties
	first and second order systems			
	 They can explain the dynamics of simple control loops and in root locus 	terpret dynamic properties	s in terms of frec	quency response a
	 They can explain the Nyquist stability criterion and the stability 	ity margins derived from it		
	 They can explain the role of the phase margin in analysis and 			
	They can explain the way a PID controller affects a control log	op in terms of its frequency	y response	
	They can explain issues arising when controllers designed in	continuous time domain ar	re implemented of	digitally
Skills				
	Students can transform models of linear dynamic systems fro		ain and vice vers	a
	 They can simulate and assess the behavior of systems and co They can design PID controllers with the help of heuristic (Zie 			
	 They can analyze and synthesize simple control loops with th 	5	equency respons	e techniques
	They can calculate discrete-time approximations of contact of the second s			
	implementation			
	They can use standard software tools (Matlab Control Toolbox	x, Simulink) for carrying ou	it these tasks	
Personal Competence				
Social Competence	Students can work in small groups to jointly solve technical problem	s, and experimentally vali	date their contro	ller designs
Autonomy	Students can obtain information from provided sources (lecture n	otes, software documenta	ation, experimen	t guides) and use
				-
	when solving given problems.			
		y control their learning pro	gress.	-
	when solving given problems. They can assess their knowledge in weekly on-line tests and thereby	y control their learning pro	gress.	
		y control their learning pro	gress.	
		y control their learning pro	igress.	-
Workload in Hours		y control their learning pro	igress.	
Workload in Hours Credit points	They can assess their knowledge in weekly on-line tests and thereb Independent Study Time 124, Study Time in Lecture 56	y control their learning pro	igress.	
	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6	y control their learning pro	igress.	
Credit points	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None	y control their learning pro	igress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	y control their learning pro	igress.	
Credit points Course achievement Examination	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	y control their learning pro	igress.	
Credit points Course achievement Examination Examination duration and	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam		igress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		igress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect	qualification: Compulsory	igress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory	qualification: Compulsory	igress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory	qualification: Compulsory tive Compulsory	igress.	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line tests and thereby Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core of Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elect Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Specia General Engineering Science (English program, 7 semester): Specia General Engineering Science (English program, 7	qualification: Compulsory tive Compulsory lisation Electrical Engineer lisation Civil Engineering: (lisation Bioprocess Enginee lisation Energy and Environ lisation Computer Science: Specialisation Mechanical E pecialisation Mechanical E pecialisation Mechanical E lisation Mechanical Engine	ing: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, Focu : Engineering, Focu : Engineering, Focus : Engineering, Focus Mat	y ing: Compulsory ocus Biomechanio us Energy System us Aircraft Syster cerials in Engineeri
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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 equationsTustin 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	urse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
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 to	the following learning results		
Professional Competence				
Knowledge	The students are able to			
	- describe the different physical mechanism of Heat Tr	ansfer,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critica	al way.		
Skills	The students are able to			
	- understand the physics of Heat Transfer,			
	- calculate and evaluate complex Heat Transfer proces	sses,		
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and d	evelop an approach.		
Automore	The students are able to develop a complex problem.	and apprint and applying the regults i		A gualified avelop.
Autonomy	The students are able to develop a complex problem s with other students is given.	sell-consistent and analyse the results i	n a critical way. I	A quaimed exchang
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Course achievement	None			
	Written exam			
	120 min			
scale				
-	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
Following Curricula	Compulsory		e e dia se Comercia	
	General Engineering Science (German program, 7 sem	-	÷ .	-
	General Engineering Science (German program, 7 sen	nester): Specialisation Mechanical Engli	neering, Focus Tr	neoretical Mechanic
	Engineering: Compulsory			
	Energy Systems: Technical Complementary Course Co			
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical I	ngineering, Foc	us Energy Systen
	Compulsory			
	General Engineering Science (English program, 7 seme		ering: Compulso	ry
	Mechanical Engineering: Specialisation Energy System	s: Compulsory		

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 Internal Combustion Engines I (L06		Lecture Recitation Section (large)	2 1	2 2
Module Responsible	Prof. Christopher Friedrich Wirz	Recitation Section (large)	-	L
Admission Requirements	-			
Recommended Previous				
Knowledge	memory namics, mechanics, machine Liements			
Educational Objectives	After taking part successfully, students have reached the fell	wing loorning results		
	After taking part successfully, students have reached the follo	Jwing learning results		
Professional Competence	As a vacult of the next medule. Fundamentals of Designeeshing	a Maabiaan (" the students are (bla to voficat fun	deneentele verendi
Knowledge	As a result of the part module "Fundamentals of Reciprocatin			
	power and working machinery and describe the qualitative a			
	multiple types of engines, compressors and pumps. They and regarding the development of power density and efficience			
	emissions. The students are able to select specific types of m	-		-
	As a result of the part module "Internal Combustion Engin			
	regarding efficiency limits. In addition, they are able to			
	characteristics and the approach of similarity. They are able Detailed knowledge is present regarding computer-aided proc		engines as well a	is charging system
Skills	The students are skilled to employ basic and detail knowled			
	They are further able to assess, analyse and solve tech	nnical and operational problem	ns and to perfo	rm mechanical a
	thermodynamic design.			
Personal Competence				
Social Competence	The students are able to communicate and cooperate in	a professional environment in	the field of ma	achinery design ai
	application.			
Autonomy	The widespread scope of gained knowledge enables the stud	ents to handle situations in thei	r future professio	in independently a
	confidently.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination Examination duration and	n Written exam			
scale	120 min			
Assignment for the	General Engineering Science (German program, 7 semest	er): Specialisation Mochanical	Engineering For	us Energy System
Assignment for the Following Curricula	Compulsory	er, specialisacion Mechanical	Lingineering, FOC	us Energy System
Following Curricula	Energy and Environmental Engineering: Core qualification: El	active Compulsory		
	Energy Systems: Technical Complementary Course Core Stud			
	General Engineering Science (English program, 7 semeste		Engineering Foo	us Energy System
	Compulsory	ay. Specialisation Mechaillean	Lingineering, POC	us Lifergy system
	company			
	Green Technologies: Energy, Water, Climate: Specialisation E	neray Technology: Elective Com	pulsory	

ανΤ	Lecture
Hrs/wk	
CP	
	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
	Prinzip der Kolbenpumpen
	Einteilung und Verwendung
Literature	A. Urlaub: Verbrennungsmotoren
	W. Kalide: Kraft- und Arbeitsmaschinen

Course L0634: Fundamentals	e 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 Combustion Engines I		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	ndependent 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	

Module M0639: Gas a	nd Steam Pow	er Plants			
Courses					
Title			Typ	Hrs /wk	CD
Gas and Steam Power Plants (L020	6)		Typ Lecture	Hrs/wk 3	CP 5
Gas and Steam Power Plants (L020			Recitation Section (large)	1	1
Module Responsible		bor	rectation section (arge)	1	-
-		liei			
Admission Requirements	None				
Recommended Previous	 "Technical The 	ermodynamics I and II"			
Knowledge	 "Heat Transfer 				
	 "Fluid Mechan 	ics"			
Educational Objectives	After taking part suc	cessfully, students hav	e reached the following learning results		
Professional Competence					
Knowledge	The students can ev	valuate the developme	ent of the electricity demand and the energy c	onversion routes	in the thermal pow
	plant, describe the v	arious types of power	plant and the layout of the steam generator blo	ck. They are also	able to determine t
	operation character	istics of the power p	lant. Additionally they can describe the exhi	aust gas cleaning	apparatus and t
	combination possibil	lities of conventional f	ossil-fuelled power plants with solar thermal a	and geothermal po	ower plants or plar
	equipped with Carbo	n Capture and Storage			
	The students have b	asic knowledge about t	he principles, operation and design of turbomac	ninery	
Skills	The students will be	able, using theories	and methods of the energy technology from	fossil fuels and ba	ased on well-found
	knowledge on the fu	nction and construction	n of gas and steam power plants, to identify bas	ic associations in t	he production of he
	and electricity, so a	s to develop conceptu	al solutions. Through analysis of the problem a	and exposure to t	he inherent interpl
	-		tudents are endowed with the capability and m		
			nd the production of heat. From the technical ba		
			ricity mix composition within the energy-politica		
			neity mix composition within the energy-politice	a changle (econon	iy, secure supply a
	environmental prote	ction).			
	Within the framewor	k of the exercise the st	udents learn the use of the specialised software	suite EBSILON Pro	fessional TM . With
			e PC, to highlight aspects of the design and deve		
	The students are ab	le to do simplified calc	culations on turbomachinery either as part of a	plant, as single co	omponent or at sta
	level.				
Personal Competence					
		he fremewerk of the le	shure is planned for shudents that are interested	The students ast	in this mean an dire
Social Competence			ecture is planned for students that are interested	-	
			region. The students will obtain first-hand expe	erience with a pov	ver plant in operati
			technical and political issues.		
Autonomy		5	able to develop alone simple simulation models		3
	this manner the the	eoretical and practical	knowledge from the lecture is consolidated a	nd the potential	effects from differe
	process combination	ns and boundary cond	litions highlighted. The students are able inde	ependently to ana	alyse the operation
	performance of steam power plants and calculate selected quantities and characteristic curves.				
Workload in Hours	Independent Study T	ime 124, Study Time ir	n Lecture 56		
Credit points	6	, ,			
Course achievement	Compulsory Bonus	Form	Description		
	No 5 %	Attestation	15-minütiges, unbenotetes Testat	über EBSILON	Professional; n
			bestanden/nicht bestanden (keine antei	ligen Punkte)	
	No 5 %	Excercises	10 Übungsaufgaben im Laufe der Vorles	-	n; bis zu 5 % Bonus
			nach Anteil richtiger Abgaben		
Examination	Written exam				
Examination duration and	Written examination	of 120 min			
scale					
Assignment for the	General Engineering	Science (German prog	ram, 7 semester): Specialisation Green Technolo	ogies. Focus Renev	vable Energy: Elect
Following Curricula	Compulsory			5, 1115 Monter	
. showing curricula		nental Engineering: Cor	re qualification: Elective Compulsory		
			Course Core Studies: Elective Compulsory		
					LUS Enorgy System
		science (English pro	ogram, 7 semester): Specialisation Mechanical	i Engineering, Foo	us energy Syster
	Elective Compulsory	France Mat Off			
	-		e: Specialisation Energy Systems: Elective Comp	-	
	-		e: Specialisation Energy Technology: Elective Co	mpulsory	
	Mechanical Engineer	ing: Specialisation Ene	rgy Systems: Elective Compulsory		

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

ourse L0210: Gas and Stear	n Power Plants
Тур	Recitation Section (large)
Hrs/wk	
CP	1
	Independent Study Time 16, Study Time in Lecture 14
	Dr. Kristin Abel-Günther
Language	
Cycle	
content	In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plants is offered, including:
	Energy balance of a fluid-flow machine
	Theory of turbine and compressor stage
	Equal and positive pressure blading
	Flow losses
	Characteristic numbers
	Axial and radial design
	Design features
	Hydraulic fluid-flow machines
	Pump and water turbine designs
	 Design examples of reciprocating engines and turbomachinery
	Steam power plants
	Gas turbine systems
	Diesel engine systems
	Waste heat utilisation
	followed by the more specialised issues:
	Electricity Demand and Forecasting
	Thermodynamic fundamentals
	Energy Conversion in Thermal Power Plants
	Types of Power Plant
	Layout of the power plant block
	Individual elements of the power plant
	Cooling systems
	Flue gas cleaning
	Operation characteristics of the power plant
	Construction materials
	Location of power plants
	The environmental impact of acidification, fine particulate or CO_2 emissions and the resulting climatic effects are a special focus
	the lecture and the lecture hall exercise. The challenges in plant operation from interconnecting conventional power plants a renewable energy sources are discussed and the technical options for providing security of supply and network stability a presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility the different solutions with the environment and climate. With this, the awareness for the responsibility of an engineer's or actions are emphasized and the potential extent of the different solutions presented clearly.
	Within the framework of the exercise the students learn the use of the specialised software suite EBSILON Professional TM . With tool small tasks are solved on the PC, to highlight aspects of the design and development of power plant cycles. The stude present their results orally and can afterwards ask questions and get feedback. The course work has a positive effect on t students final grade.
Literature	 Skripte Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990
	 Kugeler und Philippen: Energietechnik. springer-verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke u Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland

Courses				
	The United CD			
Fitle Management Tutorial (L0882)	Typ Hrs/wk CP Recitation Section (small) 2 3			
ntroduction to Management (L088				
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	e After taking this module, students know the important basics of many different areas in Business and Management, f and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to			
	 explain the differences between Economics and Management and the sub-disciplines in Management and to na important definitions from the field of Management 			
	explain the most important aspects of and goals in Management and name the most important aspects of entreprine			
	projects			
	describe and explain basic business functions as production, procurement and sourcing, supply chain managem			
	organization and human ressource management, information management, innovation management and marketing			
	 explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives uncertainty, and explain some basic methods from mathematical Finance 			
	 state basics from accounting and costing and selected controlling methods. 			
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to c out an Entrepreneurship project in a team. In particular, they are able to			
	analyse Management goals and structure them appropriately			
	analyse organisational and staff structures of companies			
	apply methods for decision making under multiple objectives, under uncertainty and under risk			
	analyse production and procurement systems and Business information systems			
	analyse and apply basic methods of marketing			
	 select and apply basic methods from mathematical finance to predefined problems 			
	 apply basic methods from accounting, costing and controlling to predefined problems 			
Personal Competence				
Social Competence	Students are able to			
	work successfully in a team of students			
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project 			
	 to communicate appropriately and to conperate respectfully with their follow students 			
	 to cooperate respectfully with their fellow students. 			
Autonomy	Students are able to			
	• work in a team and to organize the team themselves			
	 work in a team and to organize the team themselves to write a report on their project. 			
	• to write a report of their project.			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination				
	several written exams during the semester			
scale				
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory			
Following Curricula				
	Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory			
	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Data Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation 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			
	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 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 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 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 Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste			
	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 Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste 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 Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste			

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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction t	zo Management				
Тур	Lecture				
Hrs/wk	3				
CP	3				
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42				
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius				
	erstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona				
Language	E				
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. Alance-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.				

C					
Courses					
Title		Typ Lecture	Hrs/wk	CP 1	
Power Industry (L0316) Energy Systems and Energy Indust	v (L0315)	Lecture	2	2	
Renewable Energy (L0313)	,,	Lecture	2	2	
Renewable Energy (L1434)		Recitation Section (small)	1	1	
Module Responsible	Prof. Martin Kaltschmitt				
Admission Requirements	None				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have reach	ned the following learning results			
Professional Competence					
Kitowieuge	With completion of this module, the students ca efficiency. They can explain the issues occurring in distribution and power trading with regard to s applicable to many energy systems in general, et the students can explain the environmental benef	n this context. Furthermore, they can expla subject-related contexts. The students ca specially for renewable energy systems ar	in details of powe n explain these	er generation, pow aspects, which a	
Skills	Students are able to apply methodologies for detailed determination of energy demand or energy production for various types o energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design ther under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for no standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies orally and to put them them into the right context.				
Personal Competence					
-	The students are able to analyze suitable techn	ical alternatives and to assess them with	technical, econo	mical and ecologic	
	criteria under sustainability aspects. This allows the				
Autonomy	Students can independently exploit sources , ac questions.	quire the particular knowledge about the s	subject area and	transform it to n	
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	3 hours written exam				
scale					
Assignment for the	General Engineering Science (German program, 7	semester): Specialisation Process Engineer	ing: Compulsory		
Following Curricula	General Engineering Science (German program, 7	semester): Specialisation Process Engineer	ing: Compulsory		
	General Engineering Science (German program, 7	semester): Specialisation Energy and Envir	omental Enginee	ring: Compulsory	
	General Engineering Science (German program,	7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Systen	
	Elective Compulsory				
	Civil- and Environmental Engineering: Specialisati				
	Civil- and Environmental Engineering: Specialisati Civil- and Environmental Engineering: Specialisati				
	Energy and Environmental Engineering: Specialisati		1301 y		
	General Engineering Science (English program,	1 2	Engineering, Foc	us Energy Syster	
	Elective Compulsory				
	Process Engineering: Core qualification: Compulso	n/			

Course L0316: Power Industr	у			
Тур	Lecture			
Hrs/wk	1			
CP	1			
Workload in Hours	lependent 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 Cost and efficiency calculation 			
Literature	Folien der Vorlesung			

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

Course L0313: Renewable Er	iergy
Тур	Lecture
Hrs/wk	2
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 Er	lergy
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								
Fitle					Тур		Hrs/wk	СР
Advanced Mechanical Engineering					Lecture	(1)	2	2
Advanced Mechanical Engineering Advanced Mechanical Engineering					Recitation Section Lecture	on (large)	2 2	1 2
Advanced Mechanical Engineering					Recitation Section	on (large)	2	1
Module Responsible	Prof. Dieter K	rause						
Admission Requirements								
Recommended Previous								
Knowledge		nentals of Mechani	cal Engineering D	Design				
	Mechai		- Calanaa					
		nentals of Material tion Engineering	science					
	• Floude	tion Engineering						
Educational Objectives	After taking p	art successfully, st	udents have read	ched the follow	ing learning resu	lts		
Professional Competence								
Knowledge	After passing	the module, stude	nts are able to:					
	 explain 	o complex working	principles and fur	nctions of mac	nine elements an	d of basic ele	ments of fluidics	
	_	requirements, sel						
	_	e the background o						
C1-111-	A (h	the survey of the second second						
SKIIIS	After passing	the module, stude	nts are able to:					
	 accomplete 	plish dimensioning	calculations of co	overed machin	e elements,			
	 transfe 	r knowledge learne	ed in the module	to new require	ments and tasks	(problem solv	ring skills),	
	-	ize the content of t	-	is and schemat	ic sketches,			
	 evaluation 	te complex designs	s, technically.					
Personal Competence								
Social Competence								
	 Studen 	ts are able to discu	iss technical infor	rmation in the	lecture supporte	d by activating	g methods.	
Autonomy								
		ts are able to indep						. h
		ts are able to acq	uire additional kr	nowledde and	to recapitulate p	oorly underst	ood content e.g	j. by using the v
		nas of the lectures		, see the second s				
		ngs of the lectures						
Workload in Hours	recordi	ngs of the lectures Study Time 68, Stu						
Workload in Hours Credit points	recordi Independent	-						
	recordi Independent : 6	-						
Credit points	recordi Independent 5 6 None	Study Time 68, Stu						
Credit points Course achievement	recordi Independent 1 6 None Written exam	Study Time 68, Stu						
Credit points Course achievement Examination	recordi Independent 1 6 None Written exam	Study Time 68, Stu						
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir	Study Time 68, Stu	dy Time in Lectur	re 112 7 semester): Sj				
Credit points Course achievement Examination Examination duration and scale	recordi Independent : 6 None Written exam 120 General Engir General Engi	Study Time 68, Stu	dy Time in Lectur	re 112 7 semester): Sj				
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engir Compulsory	Study Time 68, Stu neering Science (Ge neering Science (dy Time in Lectur erman program, 7 (German program	re 112 7 semester): Sj m, 7 semeste	r): Specialisatio	n Mechanical	Engineering, F	Focus Biomecha
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engi Compulsory General Engi	Study Time 68, Stu	dy Time in Lectur erman program, 7 (German program	re 112 7 semester): Sj m, 7 semeste	r): Specialisatio	n Mechanical	Engineering, F	Focus Biomecha
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engi Compulsory General Engi Compulsory General Engi	Study Time 68, Stu neering Science (Ge neering Science (neering Science (dy Time in Lectur erman program, 7 (German program German program	re 112 7 semester): Sj m, 7 semester 1, 7 semester	r): Specialisatio : Specialisation	n Mechanical Mechanical E	Engineering, For	Focus Biomecha
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engi Compulsory General Engi Compulsory General Engi	Study Time 68, Stu neering Science (Ge neering Science (neering Science (neering Science (dy Time in Lectur erman program, 7 (German program German program	re 112 7 semester): Sj m, 7 semester 1, 7 semester	r): Specialisatio : Specialisation	n Mechanical Mechanical E	Engineering, For	Focus Biomecha
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engi Compulsory General Engi Compulsory General Engi Engineering: (Study Time 68, Stu neering Science (Ge neering Science (neering Science (neering Science (dy Time in Lectur erman program, 7 (German program German program German program	re 112 7 semester): Sj m, 7 semester n, 7 semester	r): Specialisatio : Specialisation : Specialisation	n Mechanical Mechanical E Mechanical E	Engineering, For	Focus Biomecha cus Energy Syste
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engi Compulsory General Engi Compulsory General Engi Engineering : General Engi	Study Time 68, Stu neering Science (Ge neering Science (neering Science (neering Science (Compulsory	dy Time in Lectur erman program, 7 (German program German program German program (German program	re 112 7 semester): Sj m, 7 semester n, 7 semester	r): Specialisatio : Specialisation : Specialisation	n Mechanical Mechanical E Mechanical E	Engineering, For	Focus Biomecha cus Energy Syste
Credit points Course achievement Examination Examination duration and scale Assignment for the	recordi Independent : 6 None Written exam 120 General Engir General Engi Compulsory General Engi Compulsory General Engi Engineering : General Engi Engineering S	Study Time 68, Stu neering Science (Ge neering Science (neering Science (neering Science (Compulsory ineering Science	dy Time in Lectur erman program, 7 (German program German program German program (German program	re 112 7 semester): Sj m, 7 semester n, 7 semester n, 7 semester m, 7 semester	r): Specialisatio : Specialisation : Specialisation er): Specialisati	n Mechanical Mechanical E Mechanical E on Mechanica	Engineering, For ingineering, For ingineering, For al Engineering,	Focus Biomecha cus Energy Syste cus Aircraft Syst Focus Material
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Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineerin
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developmen
and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic
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	
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, 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		
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		

Turn	Lecture
	2
Hrs/wk	
СР	
Workload in Hours	
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.
	 Dubbel, Taschenbuch für den Maschniehbau, Glote, KH., Feldhäsen, J.(1139.), Springer-Verlag, actuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, actuelle 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.
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	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

	als and Systems	
Courses		
Title	Typ Hrs/wk	СР
Signals and Systems (L0432)	Lecture 3	4
Signals and Systems (L0433)	Recitation Section (small) 2	2
Module Responsible	Prof. Gerhard Bauch	
Admission Requirements	None	
Recommended Previous	Mathematics 1-3	
Knowledge		
	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by 1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Lapla	
	but not required.	
	but not required.	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using method	s of signal and sys
	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time sign	als and systems. T
	can describe and analyse deterministic signals and systems mathematically in both time and image dom	
	understand the effects in time domain and image domain which are caused by the transition of a conti	nuous-time signal
	discrete-time signal.	
Skills	The students are able to describe and analyse deterministic signals and linear time-invariant systems using	-
	system theory. They can analyse and design basic systems regarding important properties such as	
D	response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time	and frequency don
Personal Competence		
	The students can jointly solve specific problems.	
Autonomy	The students are able to acquire relevant information from appropriate literature sources. They can	control their leve
	knowledge during the lecture period by solving tutorial problems, software tools, clicker system.	
	Independent Study Time 110, Study Time in Lecture 70	
Credit points		
Course achievement		
	Written exam	
Examination duration and scale		
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory	
Following Curricula		
· ····································	Data Science: Core qualification: Compulsory	
	Electrical Engineering: Core qualification: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulse	ory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Comput	sory
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,	Focus Biomecha
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Energy Syste
	Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, F	ocus Aircraft Syst
	Engineering: Compulsory	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus N	laterials in Enginee
	Sciences: Compulsory	Feerie Mechatra
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory	, FOCUS MECHALIOI
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus	Theoretical Mechar
	Engineering: Compulsory	Theoretical Preciliar
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsor	v
	General Engineering Science (English program, 7 semester): Specialisation Freese Engineering: Computer General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Computer	-
	Computational Science and Engineering: Core qualification: Compulsory	-
	Mechatronics: Core qualification: Compulsory	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory	
Course L0432: Signals and S	ystems	
Түр	Lecture	

Тур	Lecture	
Hrs/wk		
CP	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 function
 - Crosscorrelation 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	
Title	Typ Hrs/wk CP
Advanced Mechanical Design Proje	
Module Responsible	Dr. Jens Schmidt
Admission Requirements	None
Recommended Previous	
Knowledge	Mechanical Engineering: Design
	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
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.
Skille	After passing the module, students are able to:
JKIIIS	Alter 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, decument extended and the system and the data is detail.
	 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:
	• independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select
	appropriate methods,
	 to independently solve problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
	Yes None Attestation
Examination	Written exam
Examination duration and	180
scale	
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 Development
	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	:hanical 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.
	 Kolon/Mack Maschmendenmene, Witter, H., Murs, D., Jannasch, D., Vosiek, J., Springer Vieweg, aktuelle Aunage. Sowie weitere Bücher zu speziellen Themen

Courses				
Title		Тур	Hrs/wk	СР
Simulation and Design of Mechatro	nic Systems (L1822)	Lecture	2	2
Simulation and Design of Mechatro	nic Systems (L1823)	Recitation Section (large)	1	2
Simulation and Design of Mechatro	nic Systems (L1824)	Practical Course	1	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous	Fundatmentals of mechanics, control theory and	l electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calc	ulations for design, modeling, simulation and	l optimization of n	nechatronic systen
Chille	Chudonte que oble te apply modern algorithme f	n medeling of medeletropic systems. They a	n identific eineule	to and design size
SKIIIS	Students are able to apply modern algorithms for systems and implement those in laboratory con-		an identity, simula	ite and design sim
	systems and implement those in laboratory com			
Personal Competence				
Social Competence	Students are able to work goal-oriented in small	mixed groups and present results to target	groups.	
Autonomy	Students are able to recognize and improve kno	wladaa deficits independently		
Autonomy	Students are able to recognize and improve kno	wedge dencits independently.		
	With instructor assistance, students are able to	evaluate their own knowledge level and defi	ne a further cours	e 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 Eng	ineering, Focus M	lechatronics: Elect
Following Curricula	Compulsory			
	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical	Engineering, Fo	cus Aircraft Syste
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core qualification			
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Eng	ineering, Focus Tl	neoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical	Engineering, Fo	cus Aircraft Syste
	Engineering: Elective Compulsory			
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Eng	ineering, Focus M	lechatronics: Elect
	Compulsory			
	Mechanical Engineering: Specialisation Theoreti		SOLA	
	Mechanical Engineering: Specialisation Aircraft Mechanical Engineering: Specialisation Aircraft			
	Mechanical Engineering: Specialisation Aircrart			
	Mechanical Engineering: Specialisation Mechanical			
	Mechatronics: Core qualification: Compulsory	Since: Elective computery		

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 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	Course L1824: Simulation and Design of Mechatronic Systems	
Тур	Practical Course	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	NN	

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

Courses				
Title	Тур		Hrs/wk	СР
ntroduction to Control Systems (L			2	4
ntroduction to Control Systems (L0	0655) Recitation Sect	ion (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements				
	Representation of signals and systems in time and frequency domain, Laplace t	transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning res	ults		
Professional Competence				
Knowledge				
	Students can represent dynamic system behavior in time and frequency first and accord order systems	domain, and car	in particular	explain properties
	first and second order systems They can explain the dynamics of simple control loops and interpret dyn 	amic properties in	terms of free	mency response a
	root locus	unite properties in	r terms of freq	lucity response a
	They can explain the Nyquist stability criterion and the stability margins	derived from it.		
	• They can explain the role of the phase margin in analysis and synthesis of	of control loops		
	They can explain the way a PID controller affects a control loop in terms	of its frequency r	esponse	
	They can explain issues arising when controllers designed in continuous	time domain are i	mplemented of	digitally
Skills				
	Students can transform models of linear dynamic systems from time to find the second system of a		and vice vers	a
	 They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols 			
	 They can analyze and synthesize simple control loops with the help of ro 	. 5	iency response	e techniques
	They can calculate discrete-time approximations of controllers des			
	implementation			
	They can use standard software tools (Matlab Control Toolbox, Simulink)	for carrying out t	hese tasks	
Personal Competence				
	Students can work in small groups to jointly solve technical problems, and expe	erimentally validat	te their contro	ller designs
Autonomy				
	when solving given problems.			-
	They can access their knowledge in weakly on line tests and thereby control the	oir loorning progr	200	
	They can assess their knowledge in weekly on-line tests and thereby control the	en learning progre	255.	
	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Credit points Course achievement	6 None			
Credit points Course achievement Examination	6 None Written exam			
Credit points Course achievement Examination Examination duration and	6 None Written exam 120 min			
Credit points Course achievement Examination Examination duration and scale	6 None Written exam 120 min			
Credit points Course achievement Examination Examination duration and scale Assignment for the	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	6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification Bioprocess Engineering: Core qualification: Compulsory			
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compul			
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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 Jotamal model principle
	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	ependent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Herbert Werner			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M0655: Comp	utational Fluid Dynamics I			
Courses				
Title		True		CP.
Computational Fluid Dynamics I (LC	1235)	Typ Lecture	Hrs/wk 2	СР 3
Computational Fluid Dynamics I (LC		Recitation Section (large)	2	3
Module Responsible	Prof. Thomas Rung			
Admission Requirements	None			
Recommended Previous				
Knowledge	 Mathematical Methods for Engineers 			
	 Fundamentals of Differential/integral calculus and 	series expansions		
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
-	The students are able to list the basic numerics of partial	differential equations.		
5		·		
Skills	The students are able develop appropriate numerical inte	egration in space and time for the go	overning partial d	ifferential equation
	They can code computational algorithms in a structured v	vay.		
Demonstration of the second				
Personal Competence	The students can arrive at work yearshe in groups and dea	u ve e e t the e e		
Social Competence	The students can arrive at work results in groups and doo	ument them.		
A	The shuden has seen in demonstration and the second s			
Autonomy	The students can independently analyse approaches to s	biving specific problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2h			
scale				
Assignment for the	General Engineering Science (German program, 7 semes	ter): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechani
Following Curricula	Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanical	Engineering, Foo	us Aircraft Syster
	Engineering: Elective Compulsory	enter). Consideration at the table	Facility 5	
	General Engineering Science (German program, 7 sen	rester): Specialisation Mechanical	Engineering, Foc	us Energy Systen
	Elective Compulsory General Engineering Science (German program, 7 semes	tor). Specialization Naval Architectur	o: Compulson	
	General Engineering Science (German program, 7 series General Engineering Science (German program, 7 series			ring: Compulsory
	Energy Systems: Technical Complementary Course Core		omentar Enginee	ing. compulsory
	General Engineering Science (English program, 7 semest		mental Engineer	ing: Compulsory
	General Engineering Science (English program, 7 semese		-	
	Elective Compulsory		5	
	General Engineering Science (English program, 7 semest	er): Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (English program, 7 sen			us Aircraft Syste
	Engineering: Elective Compulsory		-	-
	Mechanical Engineering: Specialisation Energy Systems:	Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft Systems B	Engineering: Elective Compulsory		
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Scien			

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

Courses			
Fitle	Тур Нгз,	/wk	СР
Computer Engineering (L0321)	Lecture 3	/ ••• K	4
Computer Engineering (L0324)	Recitation Section (small) 1		2
Module Responsible	Prof. Heiko Falk		
Admission Requirements	xs None		
Recommended Previous	IS Basic knowledge in electrical engineering		
Knowledge	e		
Educational Objectives			
Professional Competence			
Knowledge	programming down to gates. The module includes the following topics:Introduction		·
	 Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combination 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 		ks
	 Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point conn 	nections, bu	sses
Skills	The students perceive computer systems from the architect's perspective, i.e., they identify the intern composition of computer systems. The students can analyze, how highly specific and individual computer collection of few and simple components. They are able to distinguish between and to explain the di today's computing systems - from gates and circuits up to complete processors. After successful completion of the medule, the students are able to interdependencies by	uters can be lifferent abs	e built based o straction layer
	After successful completion of the module, the students are able to judge the interdependencies be system and the software executed on it. In particular, they shall understand the consequences that the on the hardware-centric abstraction layers from the assembly language down to gates. This way, they the impact that these low abstraction levels have on an entire system's performance and to propose fe	he executio y will be en	n of software abled to evalu
Personal Competence	e		
Social Competence	The Students are able to solve similar problems alone or in a group and to present the results accordingly.		
Autonomy	by Students are able to acquire new knowledge from specific literature and to associate this knowledge w	vith other cl	asses.
Workload in Hours	rs Independent Study Time 124, Study Time in Lecture 56		
Credit points	ts 6		
Course achievement			
	Yes 10 % Excercises		
	n Written exam		
	d 90 minutes, contents of course and labs		
scale		lcon	
Assignment for the Following Curricula	 General Engineering Science (German program, 7 semester): Specialisation Computer Science: Computa General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Computer 		
ronowing curricula	General Engineering Science (German program, 7 semissici): Specialisation Process Engineering: Computer		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine		us Mechatror
	Compulsory	5.	
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri	ing, Focus	Aircraft Syste
	Engineering: Compulsory		
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, F Engineering: Compulsory	Focus Theor	retical Mechar
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engin Engineering Sciences: Compulsory	neering, Fo	cus Materials
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, and Production: Compulsory	Focus Prod	luct Developm
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri Compulsory	ing, Focus	Energy Syste
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineer Compulsory	ering, Focu	us Biomechar
		ulsory compulsory Engineering ompulsory	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compu General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: C General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental E General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: C General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: C General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: C General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: C Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory	ulsory compulsory Engineering ompulsory	
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compu General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: C General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental E General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: C General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: C General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Cor Computer Science: Core qualification: Compulsory	ulsory compulsory Engineering ompulsory mpulsory ory	j: Compulsory
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compu General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Ci General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental E General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Co General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Cor Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsor General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer	ulsory compulsory Engineering ompulsory mpulsory mpulsory ory ering, Focu	j: Compulsory Js Biomechar
	Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compu General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Co General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental E General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Co General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Cor Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulso General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineer Compulsory	ulsory compulsory Engineering ompulsory mpulsory mpulsory ory ering, Focu	j: Compulsory Js Biomechan

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.

ourse L0324: Computer Engineering				
Тур	ation Section (small)			
Hrs/wk	1			
CP	2			
Workload in Hours	pendent 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 De	evelopment and	Lightweigh	t Design		
Courses						
Title				Тур	Hrs/wk	СР
CAE-Team Project (L0271)				Project-/problem-based Learning	2	2
Development of Lightweight Design Products (L0270)				Lecture	2	2
Integrated Product Development I				Lecture	2	2
Module Responsible						
Admission Requirements						
Recommended Previous Knowledge	Advanced Knowledge a	bout engineering desig	n:			
Riomeuge	Fundamentals of Mecha	nical Engineering Desi	gn			
	Mechanical Engineering	: Design				
	Advanced Mechanical E	ngineering Design				
Educational Objectives	After taking part succes	sfully, students have r	eached the followi	ng learning results		
Professional Competence						
Knowledge	After completing the m	odule, students are cap	able of:			
	 explaining the full 	nctional principle of 3D	-CAD-Systems, PD	M- and FEM-Systems		
				the product development proces	55	
Skills						
SKIIIS						
	After completing the m	odule, students are abl	e to:			
		-	ems with regards	to the desired requirements su	ich as classifi	cation schemes and
	product structuri	-				
	 design an exemp 	liary product using CAL	-,PDM- and/or FEM	I-Systems with shared workload		
Personal Competence						
	After completing the m	odule, students are abl	e to:			
,						
		ject plan and allocate v esults as a team for ins		ork packages in the framework	of group discu	ssions
	• Fresent project i		tance in a present			
Autonomy	Students are capable of	f:				
	 independently ad 	lapt to a CAE-Tool and	complete a given i	practical task with it		
			j j			
	Independent Study Tim	e 96, Study Time in Leo	ture 84			
Credit points		Form	Description			
Course achievement			Description andCAE-Teampro	jekt inkl. Vortrag und Ausarbeitu	ina	
		practical work		,		
Examination	Written exam					
Examination duration and	90					
scale						
Assignment for the	General Engineering S	cience (German progr	am, 7 semester):	Specialisation Mechanical Eng	ineering, Foc	us Aircraft Systems
Following Curricula	Engineering: Compulso	-				
			m, 7 semester): Sj	pecialisation Mechanical Engine	ering, Focus P	roduct Development
	and Production: Compulsory Engineering Science: Specialisation Mechanical Engineering: Elective Compulsory					
	5 5		5 5	Specialisation Mechanical Eng	ineering Foc	is Aircraft Systems
	Engineering: Compulso		, , semester).	Episionioación Prechamical Elly		
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme					roduct Development
	and Production: Compulsory					
	General Engineering Sc	ience (English program	, 7 semester): Spe	cialisation Mechanical Engineeri	ng: Elective Co	ompulsory
				d Production: Compulsory		
	Mechanical Engineering					
	Product Development, Materials and Production: Technical Complementary Course Core Studies: Elective Compulsory					

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

Course L0269: Integrated Product Development I		
Тур	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 M0767: Aeror	autical Systems			
Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Aircraft Systems (L0741)	Lecture	2	2
Fundamentals of Aircraft Systems (Recitation Section (small)	1	1
Air Transportation Systems (L0591)		Lecture	2	2
Air Transportation Systems (L0816)		Recitation Section (large)	1	1
Module Responsible	Prof. Frank Thielecke			
Admission Requirements	None			
Recommended Previous	Basics of mathematics, mechanics and th	nermodynamics		
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students get a basic understanding of t	he structure and design of an aircraft, as well as a	n overview of th	ne systems inside
	aircraft. In addition, a basic knowledge of	f the relationchips, the key parameters, roles and wa	ys of working in	different subsyste
	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 the			
	technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems			
	the air transportation system in the context of the overall system.			
Personal Competence				
	Students are made aware of interdisciplir	nary communication in groups		
		alyze different system concepts and their technical	implementation	as well as to thi
Autonomy	system oriented.		implementation	
Workload in Hours	Independent Study Time 96, Study Time	in Locturo 94		
Credit points				
Course achievement				
Examination	Written exam			
	150 min			
scale	150 mm			
	General Engineering Science (German	program 7 semester): Specialisation Mechanical	Engineering For	us Aircraft Syste
Assignment for the General Engineering Science (German program, 7 semester): Specialisat Following Curricula Engineering: Compulsory			Linginicering, rot	
r onowing curricula		program, 7 semester): Specialisation Mechanical I	Engineering For	us Aircraft Syste
	Engineering: Compulsory	program, 7 semestery, specialisation Mechanical I	ingineering, 100	as Anciait Syste
		ictics and Mability, Elective Compulsory		
	Logistics and Mobility: Specialisation Logi			
		ffic Planning and Systems: Elective Compulsory		
		ircraft Systems Engineering: Compulsory		
	Engineering and Management Major in I	Logistics and Mobility: Specialisation Traffic Planning		

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

Course L0742: Fundamentals of Aircraft Systems		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Thielecke	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0591: Air Transporta	ation Systems	
Тур	Lecture	
Hrs/wk	2	
CP		
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	
СР	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	

Courses	
	The United CD
Fitle Management Tutorial (L0882)	Typ Hrs/wk CP Recitation Section (small) 2 3
ntroduction to Management (L088)	
Module Responsible	Prof. Christoph Ihl
Admission Requirements	
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Plann and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	 explain the differences between Economics and Management and the sub-disciplines in Management and to na important definitions from the field of Management
	 explain the most important aspects of and goals in Management and name the most important aspects of entreprneu
	projects
	describe and explain basic business functions as production, procurement and sourcing, supply chain management
	organization and human ressource management, information management, innovation management and marketing
	explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives a
	uncertainty, and explain some basic methods from mathematical Finance
	 state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to ca out an Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately
	analyse organisational and staff structures of companies
	apply methods for decision making under multiple objectives, under uncertainty and under risk
	analyse production and procurement systems and Business information systems
	analyse and apply basic methods of marketing
	 select and apply basic methods from mathematical finance to predefined problems
	 apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
-	Students are able to
Social competence	
	work successfully in a team of students
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	 to communicate appropriately and
	 to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	 work in a team and to organize the team themselves
	 to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and	several written exams during the semester
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory
	Civil, and Environmental Engineering. Coopielization Traffic and Mability, Elective Computations
	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil 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 Environmental Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
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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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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 s 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.

[352]

Тур	to Management Lecture	
Hrs/wk		
CP		
	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornel Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
Language		
	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, Innova	
	Management, Marketing and Sales	
	Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informa	
	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.	
	reliens, B., Publer, K. O., Gassen, J., Seiniom, T., Internationale Reclinitingslegung, 7. Autr., Stuttgart 2006.	
	Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. A Stuttgart 2005.	
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.	
	Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.	

Focus Materials in Engineering Sciences

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

	nced Mechanical Engin	eering Design			
Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Engineering	Design II (L0264)		Lecture	2	2
Advanced Mechanical Engineering			Recitation Section (large)	2	1
Advanced Mechanical Engineering			Lecture	2	2
Advanced Mechanical Engineering	1		Recitation Section (large)	2	1
Module Responsible					
Admission Requirements	None				
Recommended Previous	Fundamentals of Mechani	cal Engineering Design			
Knowledge	Mechanics	5 5 5			
	Fundamentals of Materials	s Science			
	Production Engineering				
Educational Objectives	After taking part successfully, st	udents have reached the	following learning results		
Professional Competence					
Knowledge	After passing the module, studer	nts are able to:			
	explain complex working	principles and functions of	of machine elements and of basic ele	ements of fluidics	,
			n scenarios and practical examples of		
	 indicate the background of 	of dimensioning calculation	ons.		
Skills	After passing the module, studer	nts are able to:			
	accomplish dimensioning	calculations of covered r	nachine elements,		
	transfer knowledge learne	ed in the module to new r	equirements and tasks (problem so	lving skills),	
	 recognize the content of t 	echnical drawings and so	hematic sketches,		
	evaluate complex designs	, technically.			
Demonstration of the second					
Personal Competence					
Social Competence	Students are able to discu	iss technical information	in the lecture supported by activatir	ng methods.	
Autonomy	 Students are able to indep 	pendently deepen their a	cquired knowledge in exercises.		
			e and to recapitulate poorly unders	stood content e.g	. by using the vide
	recordings of the lectures	-		5	, ,
	Independent Study Time 68, Stu	dy Time in Lecture 112			
Credit points			6		
Course achievement					
Examination	Written exam				
Examination Examination duration and	Written exam				
Examination	Written exam				
Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Science (Ge	1 5	ter): Specialisation Mechanical Engir	5 1	5
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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
	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.
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	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

Typ Lecture Hrwk 2 CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Vorkload in Hours Independent Study Time 32, Study Time in Lecture 28 Context Advanced Mechanical Engineering Design 1.6 II Context Advanced Mechanical Engineering Design 1.6 III Seals Clutches & brakes Belt & Chain drives Gear drives Clanclutons of thydrostatic systems (Turn	Lecture
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 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, aktualfage. 		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, aktuAuflage. 	Literature	
 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. 		
 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. 		
 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. 		
 Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktu Auflage. 		
 Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktu Auflage. 		
Auflage.		

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

Courses			
Title	Тур	Hrs/wk	СР
Signals and Systems (L0432)	Lecture	3	4
Signals and Systems (L0433)	Recitation Section (sr	mall) 2	2
Module Responsible	Prof. Gerhard Bauch		
Admission Requirements	None		
Recommended Previous	Mathematics 1-3		
Knowledge	The modul is an introduction to the theory of signals and systems. Coad knowledge i	n mathe ac covered l	w the module Math
	The modul is an introduction to the theory of signals and systems. Good knowledge i 1-3 is expected. Further experience with spectral transformations (Fourier series, F		-
	but not required.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI)	systems using meth	ods of signal and sy
	theory. They are able to apply the fundamental transformations of continuous-time	and discrete-time si	gnals and systems.
	can describe and analyse deterministic signals and systems mathematically in bot	h time and image de	omain. In particular
	understand the effects in time domain and image domain which are caused by the	ne transition of a co	ntinuous-time signa
	discrete-time signal.		
Skills	The students are able to describe and analyse deterministic signals and linear time-	nvariant systems usi	ng methods of sign
	system theory. They can analyse and design basic systems regarding importan		
	response, stability, linearity etc They can assess the impact of LTI systems on the si	ignal properties in tin	ne and frequency do
Personal Competence			
Social Competence	The students can jointly solve specific problems.		
Autonomy	The students are able to acquire relevant information from appropriate literatu	ire sources. They c	an control their le
	knowledge during the lecture period by solving tutorial problems, software tools, clic	ker system.	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and	90 min		
scale			
Assignment for the	General Engineering Science (German program, 7 semester): Core qualification: Com	ipulsory	
Following Curricula	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: Compu	lsory
	General Engineering Science (English program, 7 semester): Specialisation Bioproces	s Engineering: Comp	ulsory
	General Engineering Science (English program, 7 semester): Specialisation Computer		
	General Engineering Science (English program, 7 semester): Specialisation Me	echanical Engineerin	ig, Focus Biomech
	Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Mech	nanical Engineering,	Focus Energy Sys
	Compulsory	hanical Engineering	Feering Aircraft Cu
	General Engineering Science (English program, 7 semester): Specialisation Mec	nanicai Engineering,	FOCUS AIRCRAIT SY
	Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanic	al Engineering Focu	c Matorials in Engin
	Sciences: Compulsory	ai Engineening, rocu	
	General Engineering Science (English program, 7 semester): Specialisation M	echanical Engineeri	ng Focus Mechatr
	Compulsory	centrinear Engineerin	ig, rocus meenuu
	General Engineering Science (English program, 7 semester): Specialisation Mechani	cal Engineering. Foc	us Theoretical Mech
	Engineering: Compulsory	,	
	General Engineering Science (English program, 7 semester): Specialisation Process E	ngineering: Compuls	ory
	General Engineering Science (English program, 7 semester): Specialisation Biomedic		-
	Computational Science and Engineering: Core qualification: Compulsory	_ 5	-
	Mechatronics: Core qualification: Compulsory		
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory		
Course L0432: Signals and S	ystems		
Тур	Lecture		

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 function
 - Crosscorrelation 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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
litle .		Тур	Hrs/wk	СР
undamentals of Mechanical Prope	rties of Materials (L1090)	Lecture	2	3
Welding Technology (L1123)		Lecture	3	3
Module Responsible	Prof. Claus Emmelmann			
Admission Requirements	None			
Recommended Previous	Fundamentals of Materials Science			
Knowledge				
Educational Objectives	After taking part successfully, students h	have reached the following learning results		
Professional Competence				
Knowledge	The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowl in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dyna loads. The students get to know the most important welding technologies and the corresponding systems. They learn about influence of welding on the materials and design.		r static and dyna	
Skills	factors on the welding behaviour of stee The students are able to select between	alloys according to the desired mechaincal provide the suitable technique and system of	properties and welability.	They can distingu
Personal Competence				
Social Competence	none			
Autonomy	none			
Workload in Hours	Independent Study Time 110, Study Tim	ne in Lecture 70		
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (Germa	n program, 7 semester): Specialisation N	Aechanical Engineering	Focus Materials
Following Curricula		n program, y semestery. Specialisation i	Engineering,	rocus materials
ytulu	5 5 1 5	ogram, 7 semester): Specialisation Mechanic	al Engineering, Focus Mai	terials in Enginee
	Sciences: Compulsory			
		Materials in Engineering Sciences: Compulsor		

Course L1090: Fundamentals	s of Mechanical Properties of Materials
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Norbert Huber
Language	DE
Cycle	SoSe
Content	1. Introduction and overview
	2. Bonding and crystallography, stress, strain, linear elasticity
	3. Plasticity of metallic materials
	4. Dislocations: Structure, stress, strain, strain energy
	5. Dislocations: Motion and forces
	6. Partial dislocations, dislocation interactions, jogs and kinks
	7. Strengthening mechanisms
	8. Introduction to modelling of materials behaviour, classification of
	phenomena
	9. Linear and nonlinear elasticity
	10. Plasticity, tensile loading, cyclic loading
	11. Viscoelasticity, effects of loading history, creep, relaxation
	12. Viscoplasticity, overstress, rate sensitivity of metallic materials
	13. Identification of material parameters
Literature	Hull and Bacon: Introduction to Dislocations (1984)
	G. Gottstein: Physik. Grundlagen der Materialk. (2001)
	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
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 nichtrostende 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
ntroduction to Control Systems (L	0654)	Lecture	2	4
ntroduction to Control Systems (L0	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
	Representation of signals and systems in time and	frequency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ad the following learning results		
Professional Competence	Arter taking part successionly, students have reache	the following learning results		
Knowledge				
	Students can represent dynamic system beh	avior in time and frequency domain, and	can in particular	explain properties
	first and second order systems	tral loops and interpret dynamic propertie	in torms of from	
	 They can explain the dynamics of simple cor root locus 	itrol loops and interpret dynamic propertie	is in terms of free	quency response a
	 They can explain the Nyquist stability criterio 	on and the stability margins derived from it	t.	
	• They can explain the role of the phase margi			
	 They can explain the way a PID controller aff 	ects a control loop in terms of its frequenc	y response	
	They can explain issues arising when control	lers designed in continuous time domain a	re implemented	digitally
Skills				
	Students can transform models of linear dyn		ain and vice vers	a
	 They can simulate and assess the behavior of They can design PID controllers with the help 			
	 They can analyze and synthesize simple cont 			e techniques
	They can calculate discrete-time approxim			
	implementation			
	They can use standard software tools (Matla	o Control Toolbox, Simulink) for carrying ou	ut these tasks	
Personal Competence				
	Students can work in small groups to jointly solve to	echnical problems, and experimentally vali	idate their contro	ller designs
Autonomy	Students can obtain information from provided so	urces (lecture notes, software document	ation, experimen	t guides) and use
	where a hole a stress much have			
	when solving given problems.			
		rests and thereby control their learning pro	ouress	
	They can assess their knowledge in weekly on-line	tests and thereby control their learning pro	ogress.	
		tests and thereby control their learning pro	ogress.	
		tests and thereby control their learning pro	ogress.	
Workland in Hours	They can assess their knowledge in weekly on-line		ogress.	
	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectur		ogress.	
Credit points	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lecture 6		ogress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectur 6 None		ogress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectur 6 None Written exam		ogress.	
Credit points Course achievement Examination	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectur 6 None Written exam		ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lecture 6 None Written exam 120 min	e 56	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lecture 6 None Written exam 120 min General Engineering Science (German program, 7 s	e 56 emester): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lecture 6 None Written exam 120 min	e 56 emester): Core qualification: Compulsory sory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectur 6 None Written exam 120 min General Engineering Science (German program, 7 s Bioprocess Engineering: Core qualification: Comput	e 56 emester): Core qualification: Compulsory sory athematics: Elective Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lectur 6 None Written exam 120 min General Engineering Science (German program, 7 s Bioprocess Engineering: Core qualification: Comput Computer Science: Specialisation Computational Mi	e 56 emester): Core qualification: Compulsory sory athematics: Elective Compulsory ry	bgress.	
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 Lectur 6 None Written exam 120 min General Engineering Science (German program, 7 s Bioprocess Engineering: Core qualification: Comput Computer Science: Specialisation Computational Ma Data Science: Core qualification: Elective Compulso	e 56 emester): Core qualification: Compulsory sory athematics: Elective Compulsory ry ry	bgress.	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lecture None Written exam 120 min General Engineering Science (German program, 7 s Bioprocess Engineering: Core qualification: Comput Computer Science: Specialisation Computational M Data Science: Core qualification: Elective Compuls Electrical Engineering: Core qualification: Compuls Electrical Engineering: Core qualification: Compuls General Engineering Science (English program, 7 se General Engineering Science (Englis	e 56 emester): Core qualification: Compulsory sory athematics: Elective Compulsory ry ry ication: Compulsory emester): Specialisation Electrical Engineer emester): Specialisation Civil Engineering: emester): Specialisation Bioprocess Engine emester): Specialisation Bioprocess Engine emester): Specialisation Energy and Enviro emester): Specialisation Computer Science 7 semester): Specialisation Mechanical E	ring: Compulsory Compulsory vering: Compulsory mental Engineer : Compulsory I Engineering, Foc	ry ing: Compulsory focus Biomechania 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 Lecture None Written exam 120 min General Engineering Science (German program, 7 s Bioprocess Engineering: Core qualification: Comput Computer Science: Specialisation Computational M Data Science: Core qualification: Elective Compulso Electrical Engineering: Core qualification: Compulso Energy and Environmental Engineering: Core qualif General Engineering Science (English program, 7 se General Engineering Science (Englis	emester): Core qualification: Compulsory sory athematics: Elective Compulsory ry ry ication: Compulsory emester): Specialisation Electrical Engineer emester): Specialisation Civil Engineering: emester): Specialisation Bioprocess Engine emester): Specialisation Bioprocess Engine emester): Specialisation Computer Science 7 semester): Specialisation Mechanical E 7 semester): Specialisation Mechanical E 7 semester): Specialisation Mechanical I	ring: Compulsory Compulsory tering: Compulsor mental Engineer :: Compulsory I Engineering, Foc Engineering, Foc Engineering, Foc	ry ing: Compulsory focus Biomechanio us Energy System us Aircraft Syster
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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
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	Signals and systems
	 Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System two and stady state error, error constants
	System type and steady-state error, error constantsInternal 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 equationsTustin 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	o Control Systems
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
itle		Тур	Hrs/wk	СР
Companion Lecture for Materials S	cience Laboratory (L1088)	Lecture	2	2
Aaterial Science Laboratory (L123	5)	Practical Course	4	4
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to give a summary o	f the technical details of experiments in the	e area of materials so	iences and illust
	respective relationships. They are capable	le of describing and communicating relevant	problems and questio	ns using approp
	technical language. They can explain the	typical process of solving practical problems a	ind present related res	ults.
CL:!!!-				-
SKIIIS		ntal knowledge on material sciences to the p uring the realization of experiments in the cor	2 .	
	identity and overcome typical problems d	uning the realization of experiments in the cor	itext of material scienc	
Personal Competence				
Social Competence	Students are able to cooperate in small g	roups in order to conduct experiments in the	context of materials sci	iences. They are
	to effectively present and explain their re-	sults alone or in groups in front of a qualified a	audience.	
A	Chudents and same blanch and since much lange	in the sector of sector is to set on the sector of the sec	and deal literations. These	
Autonomy		in the context of materials sciences using p the literature and other sources provided by		y are able to fill g
Workload in Hours	Independent Study Time 96, Study Time i		the supervisor.	
Credit points		II Lecture 64		
Course achievement				
	Subject theoretical and practical work			
		nline learning modules with integrated succes	is control	
scale	rest reports on the respective tests and o	mille learning modules with megrated succes	Scontrol	
	General Engineering Science (German	program, 7 semester): Specialisation Me	chanical Engineering	Focus Material
Following Curricula			enamear Engineering,	i ocus i lateria
. choiring carriera		ogram, 7 semester): Specialisation Mechanica	al Engineering, Focus F	Product Developr
	and Production: Elective Compulsory			
		gram, 7 semester): Specialisation Mechanical	Engineering, Focus Ma	terials in Enginee
	Sciences: Compulsory	-		-
	Mechanical Engineering: Specialisation Pr	oduct Development and Production: Compulso	iry	
	Mechanical Engineering: Specialisation Ma	aterials in Engineering Sciences: Compulsory		
	Product Development, Materials and Prod	uction, Technical Complementary Course Corr	Studios: Elective Com	nulsory

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Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler
Language	DE
Cycle	WiSe
Content	Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be
	addressed are indicated in brackets for each experiment:
	1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids)
	2. notch impact test (elastic properties of solids)
	3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions)
	4. tensile test (elastic properties of solids)
	5. Identificiation of polymers (polymer physics)
	6. fiber-reinforced polymers (physical principles of composite materials)
	7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics)
	8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials)
Literature	William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011)
	William D. Callister, Materials Science and Technology, Wiley $\&$ Sons, Inc. (2007)

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

Courses				
Title		Тур	Hrs/wk	СР
Numerical Mathematics I (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 	n or english) or Analysis & Linear Alg	rebra I + II for Te	chnomathematici
Knowledge	basic MATLAB/Python knowledge	ror english) er Andrysis a Einear Aig		ennomatienatien
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, integral problems and to explain their core ideas, 	tion, least squares problems, eigenv	value problems, r	onlinear root find
	 repeat convergence statements for the numerical r explain aspects for the practical execution of nume 		utational and stor	rage complexitx.
Skills	Students are able to			
	 implement, apply and compare numerical methods justify the convergence behaviour of numerical met select and execute a suitable solution approach for 	thods with respect to the problem a	nd solution algori	thm,
Personal Competence				
	Students are able to			
	 work together in heterogeneously composed teams explain theoretical foundations and support each of 			
Autonomy	Students are capable			
	 to assess whether the supporting theoretical and pr to assess their individual progess and, if necessary, 		individually or in	i a team,
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 so	emester): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7 semest			-
	General Engineering Science (German program, 7 se	mester): Specialisation Mechanica	I Engineering, F	ocus Biomechan
	Compulsory General Engineering Science (German program, 7 semest	ter): Specialisation Mechanical Engi	eering Focus Th	eoretical Mechani
	Engineering: Compulsory			
	General Engineering Science (German program, 7 sem Engineering: Elective Compulsory			
	General Engineering Science (German program, 7 semest Compulsory	ter): Specialisation Mechanical Engi	neering, Focus M	echatronics: Elect
	General Engineering Science (German program, 7 sem Elective Compulsory	nester): Specialisation Mechanical I	Engineering, Foc	us Energy Syster
	Bioprocess Engineering: Specialisation A - General Bioproc Computer Science: Specialisation Computational Mathema		ory	
	Computer Science: Specialisation Computational Mathematics Computer Science: Specialisation II. Mathematics and Eng		ory	
	Data Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Elective Comput	lsory		
	Engineering Science: Core qualification: Compulsory			
	Engineering Science: Core qualification: Compulsory			
	General Engineering Science (English program, 7 semeste		- ·	
	General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 ser			ocus Biomechan
	Compulsory	er): Specialisation Mechanical Engine	eering, Focus Mat	erials in Engineer
	Sciences: Compulsory General Engineering Science (English program, 7 semest	er): Specialisation Mechanical Engin	eering, Focus Th	eoretical Mechan
	Sciences: Compulsory General Engineering Science (English program, 7 semest Engineering: Compulsory General Engineering Science (English program, 7 semeste	er): Specialisation Biomedical Engine	ering: Compulso	ſy
	Sciences: Compulsory General Engineering Science (English program, 7 semest Engineering: Compulsory General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semest	er): Specialisation Biomedical Engine	ering: Compulso	ſy
	Sciences: Compulsory General Engineering Science (English program, 7 semest Engineering: Compulsory General Engineering Science (English program, 7 semeste	er): Specialisation Biomedical Engine	ering: Compulso	ſy

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	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				
itle		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				
Recommended Previous	5 5 5			
Knowledge				
Educational Objectives Professional Competence	31 31	eached the following learning results		
-	This module deals with the foundations of th programming down to gates. The module incl Introduction		ers the layers fror	m the assembly-l
Skills	 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 phy 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 between and to explain the different abstraction layer			
	system and the software executed on it. In p on the hardware-centric abstraction layers fro	Fircuits up to complete processors. he students are able to judge the interdepen articular, they shall understand the consequen om the assembly language down to gates. This ave on an entire system's performance and to	ces that the exec way, they will be	ution of software e enabled to eval
Personal Competence				
-	Students are able to solve similar problems al	one or in a group and to present the results ac	cordingly.	
Autonomy	Students are able to acquire new knowledge f	rom specific literature and to associate this kno	owledge with othe	er classes.
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Course achievement		Description		
Examination	Yes 10 % Excercises			
Examination duration and				
scale				
Assignment for the		m, 7 semester): Specialisation Computer Scien	ce: Compulsory	
5	General Engineering Science (German progra			
	General Engineering Science (German progra	m, 7 semester): Specialisation Process Enginee	ring: Compulsory	
	General Engineering Science (German pro	gram, 7 semester): Specialisation Mechanic	al Engineering,	Focus Mechatron
	Compulsory			
			- · · -	
	General Engineering Science (German prog	ram, 7 semester): Specialisation Mechanical	Engineering, Foo	cus Aircraft Syst
	General Engineering Science (German prog Engineering: Compulsory			-
	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German progra	ram, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Eng		-
	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory		ineering, Focus Th	heoretical Mechar
	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German pro Engineering Sciences: Compulsory	m, 7 semester): Specialisation Mechanical Eng ogram, 7 semester): Specialisation Mechani	ineering, Focus Th	heoretical Mechar Focus Material:
	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra	m, 7 semester): Specialisation Mechanical Eng	ineering, Focus Th	heoretical Mechar Focus Material:
	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra and Production: Compulsory	m, 7 semester): Specialisation Mechanical Eng ogram, 7 semester): Specialisation Mechani ım, 7 semester): Specialisation Mechanical Eng	ineering, Focus Tł cal Engineering, gineering, Focus F	neoretical Mechar Focus Material: Product Developn
	General Engineering Science (German prog Engineering: Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory General Engineering Science (German progra and Production: Compulsory General Engineering Science (German prog	m, 7 semester): Specialisation Mechanical Eng ogram, 7 semester): Specialisation Mechani	ineering, Focus Tł cal Engineering, gineering, Focus F	neoretical Mechar Focus Material: Product Developn
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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		
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	-	
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	

Courses				
Title		Тур	Hrs/wk	СР
Enhanced Fundamentals: Ceramics		Lecture	2	2
Enhanced Fundamentals: Ceramics	-	Recitation Section (large		1
Enhanced Fundamentals: Metals (L		Lecture	2	3
Module Responsible				
Admission Requirements	None			
	Module "Fundamentals of Materials Science"			
Knowledge	Module "Materials Science Laboratory"			
	Module "Advanced Materials"			
	Module Advanced Materials			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students are able to give an enhanced of	verview over the following topics		
	in metals, polymers and ceramics: Atomic	bonds, crystal and amorphous structure	s, defects , electrical	and mass transpo
	microstructure and phase diagrams. They ar	e capable to explain the corresponding tec	hnical terms.	
Skills	The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.			
Personal Competence				
Social Competence				
	The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They shoul			
Autonomy	be able to critally evaluate the profoundness		ciumes, metals ana p	Short free short
	be usic to critary evaluate the probananes.	of their knowledge.		
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 p	rogram, 7 semester): Specialisation Me	chanical Engineering,	Focus Materials
	Engineering Sciences: Compulsory			
Ū.	Data Science: Core qualification: Elective Co	mpulsory		
	General Engineering Science (English progra		Engineering, Focus Ma	aterials in Engineeri
	Sciences: Compulsory	•		-
	General Engineering Science (English progr	am, 7 semester): Specialisation Mechanica	al Engineering, Focus	Product Developme
	and Production: Compulsory			
	Mechanical Engineering: Specialisation Mate	rials in Engineering Sciences: Compulsory		
	Technomathematics: Specialisation III. Engin	ooring Science: Elective Compulsory		

Course L1233: Enhanced Fur	idamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	
Cycle	
-	1. Einführung
	Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung Einteilung der Pulversyntheseverfahren
	Der Bayer-Prozess zur Al2O3-Herstellung
	Der Acheson-Prozess zur SiC-Herstellung
	Chemical Vapour Deposition
	Dub constituents
	Pulveraufbereitung
	Mahltechnik
	Sprühtrockner
	3. Formgebung
	5. ronngebung
	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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1086: Enhanced Fun	idamentals: Metals
Тур	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Jörg Weißmüller
Language	
Cycle	
Content	Advanced understanding of metals:
	Physical materials properties o Materials behaviour - elastic, thermal, electrical
	 Superelasticity and shape memory effect
	 Fundamentals of electrical conductivity in metals and semiconductors
	o Superconductivity
	Chemical (or "dry") corrosion
	o Driving forces and mechanisms
	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 series
	o Nernst equation
	o Polarizable electrodes
	o Electrochemical double layer
	o Capacitive and pseudocapacitive processes
	Capacitive currents and Faraday currents
	Electrochemical (or "wet") corrosion and corrosion protection
	Basic observations 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 Storage strategies
	Storage strategies Requirements for storage materials
	Requirements for storage materials State of the art
	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

Courses				
Title		Tran	Line (suls	CD
Management Tutorial (L0882)		Typ Recitation Section (small)	Hrs/wk 2	CP 3
Introduction to Management (L088	0)	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous				
Knowledge				
-	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence		ioning ioning ionics		
-	e After taking this module, students know the important basics of many different areas in Business and Management, f and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to			
	 explain the differences between Economics and M important definitions from the field of Management explain the most important aspects of and goals in projects describe and explain basic business functions as 	Management and name the mos production, procurement and s	t important aspe ourcing, supply	cts of entreprneu chain manageme
	 organization and human ressource management, info explain the relevance of planning and decision muncertainty, and explain some basic methods from m state basics from accounting and costing and selected 	aking in Business, esp. in situa athematical Finance d controlling methods.	tions under mul	tiple objectives a
Skills	Students are able to analyse business units with respect to out an Entrepreneurship project in a team. In particular, the • analyse Management goals and structure them appro	y are able to	ojectives, strateg	ies etc.) and to ca
	 analyse organisational and staff structures of compan apply methods for decision making under multiple obj analyse production and procurement systems and Bu analyse and apply basic methods of marketing select and apply basic methods from mathematical fii apply basic methods from accounting, costing and co 	ies jectives, under uncertainty and un siness information systems nance to predefined problems	nder risk	
Personal Competence Social Competence	Students are able to			
Autonomy	 work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the to communicate appropriately and to cooperate respectfully with their fellow students. Autonomy Students are able to		the project	
	 work in a team and to organize the team themselves to write a report on their project. 			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	several written exams during the semester			
scale				
Assignment for the	General Engineering Science (German program, 7 semester)	: Core qualification: Compulsory		
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil En	gineering: Elective Compulsory		
	Civil- and Environmental Engineering: Specialisation Water a	and Environment: Elective Compu	lsory	
	Civil- and Environmental Engineering: Specialisation Traffic a	and Mobility: Elective Compulsory		
	Bioprocess Engineering: Core qualification: Compulsory			
	Computer Science: Core qualification: Compulsory			
	Data Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification: C			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):			
	General Engineering Science (English program, 7 semester):		e .	-
	General Engineering Science (English program, 7 semester):			ng: Compulsory
	General Engineering Science (English program, 7 semester): General Engineering Science (English program, 7 seme Compulsory			ocus Biomechan
	General Engineering Science (English program, 7 semesi Compulsory	ter): Specialisation Mechanical I	Engineering, Foc	us Energy Syste
	General Engineering Science (English program, 7 semes Engineering: Compulsory	ter): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste

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	zo Management		
Тур	Lecture		
Hrs/wk	3		
CP	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius		
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona		
Language	DE		
Cycle	WiSe/SoSe		
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, 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. Alance-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.		

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Focus Mechatronics

In the focus "Mechatronics" students learn next to the knowledge and skills of mechanical engineering deeper knowledge and skills of electrical and

	nced Mechanical E	ngineering Design	1		
Courses					
Title			Тур	Hrs/wk	СР
Advanced Mechanical Engineering I	Design II (L0264)		Lecture	2	2
Advanced Mechanical Engineering I	Design II (L0265)		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	None				
Recommended Previous	 Fundamentals of M 	echanical Engineering Desi	ign		
Knowledge	Mechanics				
	 Fundamentals of M 	aterials Science			
	Production Engine	ering			
Educational Objectives	After taking part successf	ully, students have reached	d the following learning results		
Professional Competence	, and the succession				
•	After passing the module	students are able to:			
5					
			ons of machine elements and of basic e		
		ound of dimensioning calci	cation scenarios and practical examples	of complex machin	ne elements,
		ound of unitensioning calc			
Skills	After passing the module	students are able to:			
	accomplish dimens	ioning calculations of cove	red machine elements.		
		-	new requirements and tasks (problem s	olving skills),	
	 recognize the cont 	ent of technical drawings a	nd schematic sketches,		
	evaluate complex	designs, technically.			
Porcenal Competence					
Personal Competence Social Competence					
Social competence	Students are able t	o discuss technical informa	tion in the lecture supported by activat	ing methods.	
Autonomy					
Autonomy	 Students are able t 	o independently deepen th	eir acquired knowledge in exercises.		
	Students are able	to acquire additional know	ledge and to recapitulate poorly unde	rstood content e.g.	. by using the vid
	recordings of the le	ectures.			
Workload in Hours	Independent Study Time	68, Study Time in Lecture 1	12		
Credit points	6				
create points					
Course achievement	None				
Course achievement	Written exam				
Course achievement Examination	Written exam				
Course achievement Examination Examination duration and scale	Written exam 120	nce (German program, 7 se	mester): Specialisation Mechanical Eng	ineering: Compulso	лу
Course achievement Examination Examination duration and scale	Written exam 120 General Engineering Scie		mester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanic		-
Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie				-
Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie General Engineering Sci Compulsory	ence (German program,		cal Engineering, F	ocus Biomechani
Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie General Engineering Sci Compulsory General Engineering Scie Compulsory	ence (German program, ence (German program, 7	7 semester): Specialisation Mechanical	cal Engineering, Fi	ocus Biomechani us Energy Syster
Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie General Engineering Sci Compulsory General Engineering Sci Compulsory General Engineering Sci	ence (German program, ence (German program, 7	7 semester): Specialisation Mechanic	cal Engineering, Fi	ocus Biomechani us Energy Syster
Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie General Engineering Sci Compulsory General Engineering Sci Compulsory General Engineering Sci Engineering: Compulsory	ence (German program, ence (German program, 7 ence (German program, 7	7 semester): Specialisation Mechanica semester): Specialisation Mechanica semester): Specialisation Mechanica	al Engineering, Focul	ocus Biomechani us Energy Syster us Aircraft Syste
Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie General Engineering Sci Compulsory General Engineering Sci Compulsory General Engineering Sci Engineering: Compulsory General Engineering Sci	ence (German program, ence (German program, 7 ence (German program, 7 ience (German program,	7 semester): Specialisation Mechanical	al Engineering, Focul	ocus Biomechani us Energy Syster us Aircraft Syste
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Course achievement Examination Examination duration and scale Assignment for the	Written exam 120 General Engineering Scie General Engineering Sci Compulsory General Engineering Sci Compulsory General Engineering Sci Engineering: Compulsory General Engineering Sci Engineering Sciences: Co General Engineering Sci Compulsory General Engineering Scie and Production: Compulsory General Engineering Scie Engineering: Compulsory Energy Systems: Technic Engineering Science: Spe General Engineering Scie General Engineering Scie Compulsory General Engineering Scie General Engineering Scie General Engineering Scie General Engineering Sci Compulsory General Engineering Sci Compulsory General Engineering Sci Engineering: Compulsory	ence (German program, ence (German program, 7 ence (German program, 7 ence (German program, 7 ence (German program, mpulsory ence (German program, 7 s ory nce (German program, 7 s ory nce (German program, 7 se cialisation Mechanical Engli nce (English program, 7 ence (English program, 7 ence (English program, 7	7 semester): Specialisation Mechanical semester): Specialisation Mechanical semester): Specialisation Mechanica 7 semester): Specialisation Mechanica 7 semester): Specialisation Mechanical En- emester): Specialisation Mechanical En- emester): Specialisation Mechanical En- core Studies: Elective Compulsory meering: Compulsory mester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi	cal Engineering, Focu Engineering, Focu Engineering, Focu ical Engineering, cal Engineering, Focus P gineering, Focus P gineering, Focus Th neering: Compulsor cal Engineering, Focu Engineering, Focu	ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani 'Y ocus Biomechani us Energy Syster us Aircraft Syste

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 Med	chanical Engineering Design II
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	
Lecturer	Prof. Dieter Krause, Prof. Otto von Estorff
Language	
Cycle	
Content	Advanced Mechanical Engineering Design I & II
	Lecture
	Fundamentals of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Seals
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	• Crank drives
	 Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	• Crank gears
	 Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	
	 Dubbel, Taschenbuch f ür den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

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

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	
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
	Epicyclic gears
	Crank drives
	 Sliding bearings
	Elements of fluidics
	Exercise
	Calculation methods of the following machine elements:
	Linear rolling bearings
	• Axes & shafts
	Clutches & brakes
	Belt & chain drives
	Gear drives
	• Epicyclic gears
	Crank gears
	 Sliding bearings
	Calculations of hydrostatic systems (fluidics)
Literature	Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage.
	 Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage.
	 Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage.
	 Einführung in die DIN-Normen; Klein, M., Teubner-Verlag.
	 Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	 Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	 Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktu
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere 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					
litle		Turn	Hrs/wk	СР	
Signals and Systems (L0432)		Typ Lecture	3	4	
Signals and Systems (L0433)		Recitation Section (small)	2	2	
Module Responsible	Prof. Gerhard Bauch				
Admission Requirements	None				
-	Mathematics 1-3				
Knowledge	-				
	The modul is an introduction to the theory of signals and system				
	 1-3 is expected. Further experience with spectral transformati but not required. 	ions (Fourier series, Fourier tr	ansiorm, Lapiace	transform) is us	
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results			
Professional Competence					
Knowledge	The students are able to classify and describe signals and line	ar time-invariant (LTI) systems	s using methods o	of signal and sys	
	theory. They are able to apply the fundamental transformation		-	-	
	can describe and analyse deterministic signals and systems r				
	understand the effects in time domain and image domain wi	hich are caused by the trans	tion of a continu	ous-time signal	
Skille	discrete-time signal. The students are able to describe and analyse deterministic sig	anals and linear time invariant	systems using m	othode of signal	
JKIIIS	system theory. They can analyse and design basic system	-		-	
	response, stability, linearity etc They can assess the impact of				
Personal Competence	······································				
-	The students can jointly solve specific problems.				
	The students are able to acquire relevant information from	n appropriate literature sour	ces. They can co	ontrol their leve	
-	knowledge during the lecture period by solving tutorial problem				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (German program, 7 semester): C	ore qualification: Compulsory			
Following Curricula					
	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): 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).			ocus Biomecha	
	Compulsory	- ,			
	General Engineering Science (English program, 7 semester)): Specialisation Mechanical	Engineering, Focu	us Energy Syste	
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syst	
	Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanical Engin	eering, Focus Mat	erials in Enginee	
	Sciences: Compulsory				
	General Engineering Science (English program, 7 semeste Compulsory	er): Specialisation Mechanica	al Engineering, F	ocus Mechatroi	
	General Engineering Science (English program, 7 semester): S	necialisation Mechanical Engli	peering Focus Th	eoretical Mechar	
	Engineering: Compulsory	pecialisation mechanical Engli	icening, rocus in		
	General Engineering Science (English program, 7 semester): Sp	pecialisation Process Engineeri	ng: Compulsory		
	General Engineering Science (English program, 7 semester): Sp	-		Ъ	
		mpulsory			
	Computational Science and Engineering: Core qualification: Cor	inpulsory			
	Computational Science and Engineering: Core qualification: Cor Mechatronics: Core qualification: Compulsory				

Тур	ecture	
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 function
 - Crosscorrelation 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
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Gerhard Bauch
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Simulation and Design of 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 ar	nd electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and cal	culations for design, modeling, simulation an	d optimization of r	nechatronic system
Skills	Students are able to apply modern algorithms		can identify, simula	ate and design sim
	systems and implement those in laboratory co	nditions.		
Personal Competence				
Social Competence	Students are able to work goal-oriented in sma	II mixed groups and present results to target	groups.	
Autonomy	Students are able to recognize and improve kn	owledge deficits independently.		
	With instructor assistance, students are able to	evaluate their own knowledge level and det	ine a further cours	e of study.
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	90 min			
scale				
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical En	gineering, Focus M	Aechatronics: Electi
Following Curricula	Compulsory			
	General Engineering Science (German progr	am, 7 semester): Specialisation Mechanica	l Engineering, Fo	cus Aircraft Syster
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core qualificat	ion: Compulsory		
	General Engineering Science (English program	, 7 semester): Specialisation Mechanical Eng	gineering, Focus T	heoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (English progra	am, 7 semester): Specialisation Mechanica	I Engineering, Fo	cus Aircraft Syster
	Engineering: Elective Compulsory			
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanical En	gineering, Focus M	lechatronics: Electi
	Compulsory			
	Mechanical Engineering: Specialisation Theore		llsory	
	Mechanical Engineering: Specialisation Aircraft			
	Mechanical Engineering: Specialisation Aircraft			
	Mechanical Engineering: Specialisation Mechan			
	Mechanical Engineering: Specialisation Mechat Mechatronics: Core qualification: Compulsory	Tomes. Elective Compulsory		

Course L1822: Simulation and Design of Mechatronic Systems	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	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	purse 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		
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

Courses				
		Turn	Hac hule	CP.
Title Circuit Theory (L0566)		Typ Lecture	Hrs/wk 3	CP 4
Circuit Theory (L0567)		Recitation Section (small)	2	2
	Prof. Alexander Kölpin			
Admission Requirements				
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	r calculating electrical circuits. They know	v the Fourier ser	ies analysis of linea
	networks driven by periodic signals. They know the	e methods for transient analysis of linea	ir networks in tir	me and in frequenc
	domain, and they are able to explain the frequency	behaviour and the synthesis of passive tv	o-terminal-circui	ts.
Chille	The students are able to coloulate surrouts and u	alterer in linear actually by means of	haaia mathada	alaa uubaa duiyaa b
SKIIIS	The students are able to calculate currents and v periodic signals. They are able to calculate transien			
	respective transient behaviour. They are able to			
	circuits.			
Personal Competence				
Social Competence	Students work on exercise tasks in small guided	groups. They are encouraged to present	and discuss the	eir results within th
	group.			
Autonomy	The students are able to find out the required meth	nods for solving the given practice problem	ns. Possibilities a	re given to test the
	knowledge during the lectures continuously by r	neans of short-time tests. This allows	them to control	independently the
	educational objectives. They can link their gained ki	nowledge to other courses like Electrical E	ngineering I and	Mathematics I.
Manda ad In Harris	la des es destr Churche Times 110. Churche Times in La shure	- 70		
Credit points	Independent Study Time 110, Study Time in Lecture	270		
Course achievement				
	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program,	7 semester): Specialisation Mechanica	I Engineering,	Focus Mechatronic
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 s	emester): Specialisation Electrical Engine	ering: Compulsor	1
	Electrical Engineering: Core qualification: Compulso	ry		
	Engineering Science: Specialisation Electrical Engine			
	General Engineering Science (English program,	7 semester): Specialisation Mechanica	Engineering,	Focus Mechatronic
	Compulsory			
	Computational Science and Engineering: Specialisat	cion II. Mathematics & Engineering Science	Elective Compu	lisory
	Mechatronics: Core qualification: Compulsory	Science: Elective Compulson		
	Technomathematics: Specialisation III. Engineering	Science. Liecuve compuisory		

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	rse 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				
Гitle		Тур	Hrs/wk	СР
ntroduction to Control Systems (L	0654)	Lecture	2	4
ntroduction to Control Systems (L	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements				
	Representation of signals and systems in time and frequency d	omain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence		ing learning results		
Knowledge				
	 Students can represent dynamic system behavior in tim first and second order systems 	e and frequency domain, and	can in particular	explain properties
	first and second order systems They can explain the dynamics of simple control loops a 	nd interpret dynamic propertie	es in terms of free	quency response a
	root locus			
	They can explain the Nyquist stability criterion and the s	tability margins derived from i	t.	
	They can explain the role of the phase margin in analysi	s and synthesis of control loop	S	
	They can explain the way a PID controller affects a contr			
	 They can explain issues arising when controllers designed 	ed in continuous time domain a	are implemented	digitally
Skills		e		
	 Students can transform models of linear dynamic system They can simulate and access the behavior of systems a 		ain and vice vers	a
	 They can simulate and assess the behavior of systems a They can design PID controllers with the help of heuristic 			
	 They can analyze and synthesize simple control loops with 			e techniques
	• They can calculate discrete-time approximations of	controllers designed in con	tinuous-time an	d use it for digi
	implementation			
	They can use standard software tools (Matlab Control To	olbox, Simulink) for carrying o	ut these tasks	
Personal Competence				
-	Students can work in small groups to jointly solve technical pro	blems, and experimentally val	idate their contro	oller designs
Autonomy	Students can obtain information from provided sources (lect	ure notes, software document	ation, experimen	t guides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-line tests and th	ereby control their learning pro	naress	
	They can assess their knowledge in weekly on-line tests and th	ereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and th	ereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests and th	ereby control their learning pro	ogress.	
Werkland in Hours		ereby control their learning pro	ogress.	
	Independent Study Time 124, Study Time in Lecture 56	ereby control their learning pro	ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56	ereby control their learning pro	ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 56	ereby control their learning pro	ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	ereby control their learning pro	ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min	ereby control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): C		ogress.	
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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 plots
	Root locus design of PID controllers
	Frequency response techniques
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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 equationsTustin 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	urse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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Media Responsible Implicit provided Amission Resumented Previous Back Extended in electrical engineering Scienced and the taking part successfully, students have reached the following learning results Professional Competence Scienced and Science Comparison of the Science Computing systems. It covers the layers from the assembly-1 programming down to gates. The module includes the following logics. • Introduction • Combadiational Digo: Greds. Boolean addetra, Boolean functions, hardware synthesis, combinational networks • Sequential logic; The/Point submatch in the synthesis admentation, multiplication and division • Engineering and the science Point Systems from the activation of the Science Point Science Point Science Point Science Point Point Science Point Poi	Computer Engineering (L0321)				
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Becommended Previous (Solveded) Suit: Unordeging in deticitial engineering Educational Objective Accounted (Control of Control of Con	Module Responsible	Prof. Heiko Falk			
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		 Sequential logic: Flip-flops, automata, syste Technological foundations Computer arithmetic: Integer addition, sub Basics of computer architecture: Programm 	ematic hardware design traction, multiplication and division ning models, MIPS single-cycle architecture,		VOFKS
 composition of computer systems. The students can analyze, how highly specific and individual these in a distribution of fear and simple componets. They are able to dispute the transmission and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical comp explanation and the software exercised on it. In particular, they shall understand the consequences that the excellation software exercised on the particular. They shall understand the consequences that the excellation software exercised on the particular. They shall understand the consequences that the excellation software exercise distraction levels have on an entre system's performance and to propose fleasible options. <i>Autonom</i> Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. <i>Vorkhoal</i> In Hours Course achievemetic in the software and the software and to associate this knowledge with other classes. <i>Vorkhoal</i> In Hours Course achievemetic in the software and particular. They and the associate this knowledge with other classes. <i>Vorkhoal</i> In Hours Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. <i>Vorkhoal</i> In Hours Course achievemetic in the software in the software and table in the software and the software and the software and the software and table in the software and the software an				oint connections,	busses
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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 Form Description Reservation Written exam Description Examination duration and Scale Onimules, contents of course and labs Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatror Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatror Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatror Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatror Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechar Compulsory Genereral Engineering Sci		system and the software executed on it. In partic on the hardware-centric abstraction layers from t	ular, they shall understand the consequence the assembly language down to gates. This	es that the execu way, they will be	ition of software enabled to eval
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	Assignment for the	General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program, 7 Engineering: Compulsory General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, and Production: Compulsory General Engineering Science (German program, and Production: Compulsory General Engineering Science (German program, compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, General Engineering Science (German program, 7 General Engineering Science (German program, 7 Computer Science: Core qualification: Elective Compul Electrical Engineering Science (English program, 7	 semester): Specialisation Civil Engineering: semester): Specialisation Process Engineer m, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin 7 semester): Specialisation Mechanical Ingin 7 semester): Specialisation Mechanical Engin semester): Specialisation Naval Architectur semester): Specialisation Energy and Envir semester): Specialisation Electrical Engineer sory sory sory semester): Specialisation Civil Engineering: 	Compulsory ing: Compulsory il Engineering, Foc eneering, Focus Th al Engineering, Focus Th al Engineering, Focus P Engineering, Focus P Engineering, Focus I Engineering, Focu eering: Compulsory eering: Compulsory ering: Compulsory Compulsory	us Aircraft Syst eoretical Mecha Focus Material roduct Developr us Energy Syste ocus Biomecha ry ing: Compulsory ry

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.

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 Numerical Mathematics I (L0417)		Typ Lecture	Hrs/wk	CP 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 Alg	gebra I + II for Te	chnomathematici
	 basic MATLAB/Python knowledge 			
Educational Objectives	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 problems and to explain their core ideas, repeat convergence statements for the num explain aspects for the practical execution o 	erical methods,		
Skills	Students are able to			
	 implement, apply and compare numerical m 	ethods using MATLAB/Python,		
	 justify the convergence behaviour of numeri select and execute a suitable solution appro 	ical methods with respect to the problem a	nd solution algori	thm,
Personal Competence				
	Students are able to			
	 work together in heterogeneously composed explain theoretical foundations and support 			
Autonomy	Students are capable			
	 to assess whether the supporting theoretica 	I and practical excercises are better solved	individually or in	a team,
	• to assess their individual progess and, if nec		, .	
Workload in Hours	Independent Study Time 124, Study Time in Lectur	re 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	90 minutes			
	General Engineering Science (German program, 7	semester): Specialisation Computer Science	e: Compulsory	
	General Engineering Science (German program			Focus Materials
	Engineering Sciences: Compulsory			
	General Engineering Science (German program, 7	semester): Specialisation Biomedical Engin	eering: Compulso	ry
	General Engineering Science (German program	, 7 semester): Specialisation Mechanica	l Engineering, F	ocus Biomechan
	Compulsory General Engineering Science (German program, 7	semester). Specialisation Mechanical Engi	eering Focus Th	eoretical Mechan
	Engineering: Compulsory	Seriester). Specialisation mechanical Engi	leening, rocus m	
	General Engineering Science (German program, Engineering: Elective Compulsory	7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engli	neering, Focus M	echatronics: Elect
	Compulsory			
	General Engineering Science (German program, Elective Compulson	7 semester): Specialisation Mechanical I	ingineering, 100	us Energy System
	Elective Compulsory			us Energy System
		Bioprocess Engineering: Elective Compulso		us Energy System
	Elective Compulsory Bioprocess Engineering: Specialisation A - General	Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory	iry	us Energy System
	Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core qualification: Compulsory	Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso	iry	us Energy System
	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 (Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory	iry	us Energy System
	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)	Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory	iry	us Energy Syster
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	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 s	Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory Y Y emester): Core qualification: Compulsory emester): Specialisation Computer Science	ry pry : Compulsory	
	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 s General Engineering Science (English program, 7 s General Engineering Science (English program, Compulsory	Bioprocess Engineering: Elective Compulse lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory Y Y emester): Core qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical	ory ory : Compulsory Engineering, F	ocus Biomechan
	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 s General Engineering Science (English program, 7 s General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 s	Bioprocess Engineering: Elective Compulse lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory Y Y emester): Core qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical	ory ory : Compulsory Engineering, F	ocus Biomechan
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	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 s General Engineering Science (English program, 7 s General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 s Sciences: Compulsory General Engineering Science (English program, 7 s Sciences: Compulsory General Engineering Science (English program, 7 s Sciences: Compulsory	Bioprocess Engineering: Elective Compulse lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory Y Y emester): Core qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine	ory pry Compulsory Engineering, F eering, Focus Mat eering, Focus Th	ocus Biomechan erials in Engineer eoretical Mechan
	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 s General Engineering Science (English program, 7 s General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 s Sciences: Compulsory General Engineering Science (English program, 7 s Sciences: Compulsory General Engineering Science (English program, 7 s	Bioprocess Engineering: Elective Compulse lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory Y Y emester): Core qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine	ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulsor	ocus Biomechan erials in Engineer eoretical Mechan 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 Mathematics I			
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Sabine Le Borne		
Language	EN		
Cycle	WiSe		
Content	 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		CP
Management Tutorial (L0882)	Typ Hrs/wk Recitation Section (small) 2	СР 3
ntroduction to Management (L088		3
Module Responsible	e Prof. Christoph Ihl	
Admission Requirements		
Recommended Previous		
Knowledge	-	
	s After taking part successfully, students have reached the following learning results	
Professional Competence		
-	e After taking this module, students know the important basics of many different areas in Business and Mana and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are	
	 explain the differences between Economics and Management and the sub-disciplines in Managimportant definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects 	
	 describe and explain basic business functions as production, procurement and sourcing, supply organization and human ressource management, information management, innovation management explain the relevance of planning and decision making in Business, esp. in situations under muncertainty, and explain some basic methods from mathematical Finance 	and marketing
	state basics from accounting and costing and selected controlling methods.	
Skills	Is Students are able to analyse business units with respect to different criteria (organization, objectives, strate out an Entrepreneurship project in a team. In particular, they are able to	egies etc.) and to c
	analyse Management goals and structure them appropriately	
	 analyse organisational and staff structures of companies 	
	 apply methods for decision making under multiple objectives, under uncertainty and under risk 	
	 analyse production and procurement systems and Business information systems 	
	analyse and apply basic methods of marketing	
	 select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems 	
Personal Competence	e	
•	e Students are able to	
	 work successfully in a team of students 	
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report 	on the project
	 to communicate appropriately and 	
	 to cooperate respectfully with their fellow students. 	
Autonomv	y Students are able to	
, aconomy		
	 work in a team and to organize the team themselves 	
	to write a report on their project.	
	s Independent Study Time 110, Study Time in Lecture 70	
Credit points		
Course a shire was to		
Course achievement	n Subject theoretical and practical work	
Examination	a coveral written evame during the competer	
Examination Examination duration and	d several written exams during the semester	
Examination Examination duration and scale	e	
Examination Examination duration and scale Assignment for the	e General Engineering Science (German program, 7 semester): Core qualification: Compulsory	
Examination Examination duration and scale Assignment for the	e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory	
Examination Examination duration and scale Assignment for the	 e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory 	
Examination Examination duration and scale Assignment for the	 e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory 	
Examination Examination duration and scale Assignment for the	e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory	
Examination Examination duration and scale Assignment for the	e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory	
Examination Examination duration and scale Assignment for the	e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory	
Examination Examination duration and scale Assignment for the	e General Engineering Science (German program, 7 semester): Core qualification: Compulsory a Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory	
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Examination Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulso General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering, 7 semester): Specialisation Energy and Environmental Engineering General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering 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, Compulsory 	sory eering: Compulsory Focus Biomechar
Examination Examination duration and scale Assignment for the	 General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: 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 Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering 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 Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory 	sory eering: Compulsory Focus Biomechar
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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 busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.
	Relevante Literatur aus der korrespondierenden Vorlesung.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

	o Management
Тур	
Hrs/wk	
СР	3
	Independent Study Time 48, Study Time in Lecture 42
Lecturer	
Language	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona DE
	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, Innovati Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informatio Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects
Literature	 Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufluttgart 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
Semiconductor Circuit Design (L076	33)	Lecture	3	4
Semiconductor Circuit Design (L086	54)	Recitation Section (small)	1	2
Module Responsible	Prof. Matthias Kuhl			
Admission Requirements	None			
	Fundamentals of electrical engineering			
Knowledge				
	Basics of physics, especially semiconductor physics			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
-	 Students are able to explain the functionality or 		uits.	
	 Students are able to explain how analog circuit 			
	 Students are able to explain the functionality or 			
	 Students know the fundamental digital logic cir 	-	-	5.
	 Students have knowledge about memory circuit 		d specifications.	
	 Students know the appropriate fields for the us 	e of bipolar transistors.		
Skills	 Students can calculate the specifications of diff 	erent MOS devices and can define the p	arameters of elect	tronic circuits.
	 Students are able to develop different logic circ 			
	 Students can use MOS devices, operational am 			
Personal Competence				
Social Competence	Charles have a bla words officiantly in hotensor			
	Students are able work efficiently in heterogen		auastiana	
	Students working together in small groups can	solve problems and answer professional	questions.	
Autonomy				
Autonomy	Students are able to assess their level of knowl	edge.		
	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points				
Course achievement Examination				
Examination duration and				
scale	120 1111			
Assignment for the	General Engineering Science (German program, 7 ser	nester): Specialisation Electrical Engine	erina: Compulsory	
-	General Engineering Science (German program, 7			ocus Mechatron
3	Compulsory		5 - 5,	
	Data Science: Core qualification: Elective Compulsory			
	Electrical Engineering: Core gualification: Compulsory			
	Engineering Science: Specialisation Electrical Enginee	ring: Compulsory		
	Engineering Science: Specialisation Mechatronics: Co			
	General Engineering Science (English program, 7 sem		ring: Compulsorv	
	General Engineering Science (English program, 7			ocus Mechatron
	Compulsory		5 - 5, -	
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechatronics: Con	npulsory	
	Computational Science and Engineering: Specialisatio			sory
	Mechanical Engineering: Specialisation Mechatronics:		1	-
	Mechatronics: Core qualification: Compulsory			

Course L0763: Semiconducto	or Circuit Design
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Matthias Kuhl
Language	DE
Cycle	SoSe
Content	 Repetition Semiconductorphysics and Diodes Functionality and characteristic curve of bipolar transistors Basic circuits with bipolar transistors Functionality and characteristic curve of MOS transistors Basic circuits with MOS transistors for amplifiers Operational amplifiers and their applications Typical applications for analog and digital circuits Realization of logical functions Basic circuits with MOS transistors for combinational logic Memory circuits Basic circuits with MOS transistors for sequential logic Basic concepts of analog-to-digital and digital-to-analog-converters
Literature	U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Course L0864: Semiconducto	or Circuit Design
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Kuhl, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 Basic circuits and characteristic curves of bipolar transistors Basic circuits and characteristic curves of MOS transistors for amplifiers Realization and dimensioning of operational amplifiers Realization of logic functions Basic circuits with MOS transistors for combinational and sequential logic Memory circuits Circuits for analog-to-digital and digital-to-analog converters Design of exemplary circuits
Literature	 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo

Module M0854: 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
				1
Complex Functions (L1041)		Recitation Section (small)	1 1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students can name the basic concepts in Mathematics IV	. They are able to explain ther	n using appropria	ate examples.
	Students can discuss logical connections between these	concepts. They are capable	of illustrating the	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce them. 			
Skills				
	Students can model problems in Mathematics IV with th		ed in this course	. Moreover, they are
	capable of solving them by applying established methods			
	Students are able to discover and verify further logical co			
	 For a given problem, the students can develop and ex secults 	ecute a suitable approach, ai	nd are able to cr	itically evaluate the
	results.			
Demonstration of the second second				
Personal Competence				
Social Competence	 Students are able to work together in teams. They are ca 	pable to use mathematics as a	a common langua	age.
	 In doing so, they can communicate new concepts accord 	ling to the needs of their coop	erating partners.	Moreover, they can
	design examples to check and deepen the understanding	of their peers.		
Autonomy	- Chudonka are conclude of checking their understanding of	formulay concents on their o	They can an	
	 Students are capable of checking their understanding of provide the provide the part half in activity them. 	complex concepts on their o	wn. They can sp	ecity open questions
	precisely and know where to get help in solving them.	bla to work for langer period	c in a goal oright	ad mannar on hard
	 Students have developed sufficient persistence to be a problems 	ble to work for longer period	s in a goal-orient	led manner on nard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points Course achievement				
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equations 2)			
scale	oo min (complex randions) + oo min (Dirierential Equations 2)			
	General Engineering Science (German program, 7 semester): Sp	pecialisation Electrical Engineer	ring: Compulson	1
Following Curricula		-		
	Compulsory		. Engliseening, i	
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Architecture	e: Compulsory	
	General Engineering Science (German program, 7 semester): S			eoretical Mechanical
	Engineering: Elective Compulsory	, <u>.</u>	<u>.</u> ,	
	Computer Science: Specialisation Computational Mathematics:	Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Electrical Engineer	ing: Compulsory	
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanica	l Engineering, F	ocus Mechatronics:
	Compulsory			
	General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanical Engin	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory			
	Computational Science and Engineering: Specialisation II. Mathe	ematics & Engineering Science	Elective Compu	lsory
	Mechanical Engineering: Specialisation Mechatronics: Compulso	ry		
	Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory			
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complementary	Course Core Studies: Elective	Compulsory	

Typ Lect Hrs/wk 2 CP 1 Workload in Hours Index	ture
CP 1	
Workload in Hours Inde	
	lependent Study Time 2, Study Time in Lecture 28
Lecturer Doz	zenten des Fachbereiches Mathematik der UHH
Language DE	
Cycle SoS	Se
Content Main	in 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

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

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

Course L1038: Complex Functions		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	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 Functions		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Focus Product Development and Production

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

Module M0725: Produ	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				
Admission Requirements Recommended Previous	None			
Keconmended Previous Knowledge	no course assessments required			
kilowicuge	internship recommended			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence		5 5		
-	Students are able to			
5				
	 name basic criteria for the selection of manu 			
	 name the main groups of Manufacturing Tec 			
	 name the application areas of different many 			
	 name boundaries, advantages and disadvan 			
	 describe elements, geometric properties and applications of the second state of the second st		tools, workpiece	and process.
	 explain the essential models of manufacturing 	ig technology.		
Skills	Students are able to			
	select manufacturing processes in accordance			
	design manufacturing processes for simple t		e component to t	e produced.
	 assess components in terms of their product 	ion-oriented construction.		
Personal Competence				
-	Students are able to			
Social competence				
	 develop solutions in a production environme 	nt with qualified personnel at technical lev	el and represent	decisions.
Autonomy				
Autonomy	Students are able to			
	 interpret independently the manufacturing p 	rocess.		
	 assess own strengths and weaknesses in get 	neral.		
	 assess their learning progress and define ga 			
	 assess possible consequences of their action 	1 5.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points				
Course achievement				
Examination				
Examination duration and	120 min			
scale				
÷	General Engineering Science (German program, 7	semester): Specialisation Mechanical Engi	ineering, Focus F	roduct Developmer
Following Curricula	and Production: Compulsory	competer), Engelation Machanist	pooring Farmer	oprotical Mr
	General Engineering Science (German program, 7	semester): specialisation Mechanical Engli	ieering, Focus Tr	ieureticai Mechanica
	Engineering: Elective Compulsory	Compulsory		
	Digital Mechanical Engineering: Core qualification:			
	Engineering Science: Specialisation Mechanical Eng General Engineering Science (English program, 7 s		ering Computer	D/
	General Engineering Science (English program, 7 s General Engineering Science (English program, 7			-
	and Production: Compulsory	semester), specialisation Mechanical Engl	neering, rocus F	roduct Developmen
	General Engineering Science (English program, 7 s	emester): Specialisation Mechanical Engin	eering Focus Th	eoretical Mechanic
	Engineering: Elective Compulsory	emestery, specialisation Mechanical Engli	icening, rocus II	
	Logistics and Mobility: Specialisation Engineering S	cience: Elective Compulsorv		
	Mechanical Engineering: Core qualification: Compu			
	Mechatronics: Core qualification: Compulsory	-		

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

Course L0612: Production En	igineering 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 Er	igineering II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	 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	igineering 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
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		Recitation Section (large)	2	1
Module Responsible				
Admission Requirements				
Recommended Previous	 Fundamentals of Mechanical Engli 	neering Design		
Knowledge	Mechanics			
	Fundamentals of Materials Science	e		
	Production Engineering			
	After taking part successfully, students h	have reached the following learning results		
Professional Competence				
Knowledge	After passing the module, students are a	able to:		
	 explain complex working principle 	es and functions of machine elements and of basic ele	ements of fluidics,	
		riteria, application scenarios and practical examples of		
	 indicate the background of dimen 	isioning calculations.		
Skills	After passing the module, students are a	able to:		
	 accomplish dimensioning calculat 	ions of covered machine elements,		
	 transfer knowledge learned in the 	e module to new requirements and tasks (problem sol	lving skills),	
	 recognize the content of technica 	l drawings and schematic sketches,		
	• evaluate complex designs, techni	cally.		
Personal Competence				
Social Competence	 Students are able to discuss tech 	nical information in the lecture supported by activatir	na methods.	
Autonomy		ly deepen their acquired knowledge in exercises.		
		ditional knowledge and to recapitulate poorly unders	stood content e a	by using the vid
	recordings of the lectures.	and the recupitalate poorly and the	stood content e.g.	. by using the vie
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				
		rogram, 7 semester): Specialisation Mechanical Engir		
Following Curricula		n program, 7 semester): Specialisation Mechanica	al Engineering, F	ocus Biomechani
	Compulsory			
	5 5 .	program, 7 semester): Specialisation Mechanical	Engineering, Foci	
	Compulsory			us Energy Syster
				5, ,
	General Engineering Science (German	program, 7 semester): Specialisation Mechanical	Engineering, Foc	5, ,
	General Engineering Science (German Engineering: Compulsory			us Aircraft Syste
	General Engineering Science (German Engineering: Compulsory General Engineering Science (Germa	program, 7 semester): Specialisation Mechanical n program, 7 semester): Specialisation Mechanic		us Aircraft Syste
	General Engineering Science (German Engineering: Compulsory General Engineering Science (Germa Engineering Sciences: Compulsory	n program, 7 semester): Specialisation Mechanic	cal Engineering,	us Aircraft Syste Focus Materials
	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German		cal Engineering,	us Aircraft Syste Focus Materials
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	General Engineering Science (German Engineering: Compulsory General Engineering Science (German Engineering Sciences: Compulsory General Engineering Science (German Compulsory General Engineering Science (German p	n program, 7 semester): Specialisation Mechanic	cal Engineering, al Engineering, F	us Aircraft Syste Focus Materials Focus Mechatroni
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Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Typ	Lecture
Hrs/wk	2
CP	2
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	DE
Cycle	
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.
	Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage.
	Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktu
	Auflage.
	Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

Course L0265: Advanced Me	chanical 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

-	L selous
	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	
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.
	 Konstruktionsteine, Fain, G., beitz, W., Springer-verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage.
	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	chanical 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
Advanced Mechanical Design Proje				6
Module Responsible	Dr. lens Schmidt			
Recommended Previous				
Knowledge	Mechanical Engineering: Design			
	Advanced Mechanical Engineering Design			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
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, 			
	 convert principle solutions into a detailed design, 			
	 use methods to design and solve engineering design tasks systematically an 	d solution-orien	ted,	
	create a technical documentation including all necessary technical drawings			of the system,
	document calculations of selected machine elements clearly and in detail.			
Personal Competence				
-	After passing the module, students are able to:			
,				
	 present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course 			
	• Tenect 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 nece	essary know	ledge and select
	appropriate methods,			5
	 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 Me	echanical Engine	eering, Focu	us Aircraft Syste
Following Curricula	Engineering: Compulsory			
	General Engineering Science (German program, 7 semester): Specialisation Mecha	anicai Engineerii	ng, Focus Pr	oduct Developm
	and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Me	echanical Engin	eering Foc	is Aircraft Sveto
	Engineering: Compulsory		comy, roct	is Anciait Syste
	General Engineering Science (English program, 7 semester): Specialisation Mecha	anical Engineerir	ng, Focus Pr	oduct Developm
	and Production: Compulsory	5		
	General Engineering Science (English program, 7 semester): Specialisation Mechan	nical Engineerin	g, Focus The	eoretical Mechan
	Engineering: Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			

Course L0266: Advanced Me	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
ntroduction to Control Systems (L0	654)	Lecture	2	4
ntroduction to Control Systems (LC	655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and	d frequency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	Students can represent dynamic system by	ebayior in time and frequency domain and	can in narticular	explain properties
	first and second order systems	enavior in and nequency domain, and	currin purcicului	explain properties
	• They can explain the dynamics of simple c	ontrol loops and interpret dynamic propertie	es in terms of free	quency response ar
	root locus			
	 They can explain the Nyquist stability crite 	rion and the stability margins derived from i	t.	
	They can explain the role of the phase mar			
	They can explain the way a PID controller a			-U U
	 They can explain issues arising when contr 	ollers designed in continuous time domain a	ire implemented	digitally
Skills	Students can transform models of linear dy	namic systems from time to frequency dom	ain and vice vers	2
	 They can simulate and assess the behavior 			d
	 They can design PID controllers with the he 			
	 They can analyze and synthesize simple co 			e techniques
	They can calculate discrete-time approx	ximations of controllers designed in con	tinuous-time and	d use it for digit
	implementation			
	They can use standard software tools (Mat	lab Control Toolbox, Simulink) for carrying o	ut these tasks	
Personal Competence				
	Students can work in small groups to jointly solve	technical problems, and experimentally val	idate their contro	ller designs
Autonomy	Students can obtain information from provided			
,	when solving given problems.			5
	They can access their traculades in westly, on lin	a taska and thereby, control their locuring pro-		
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pro	ogress.	
			ogress.	
	Independent Study Time 124, Study Time in Lecte		ogress.	
Credit points	Independent Study Time 124, Study Time in Lecto		ogress.	
	Independent Study Time 124, Study Time in Lectu 6 None		ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecto 6 None Written exam		ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecto 6 None Written exam		ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min	ure 56	ogress.	
Credit points Course achievement Examination Examination duration and	Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7	ure 56 / / semester): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min	vre 56 / semester): Core qualification: Compulsory ulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7 Bioprocess Engineering: Core qualification: Comp	ure 56 ' semester): Core qualification: Compulsory ulsory Mathematics: Elective Compulsory	ogress.	
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ĺ	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 to Control Systems			
Тур	Lecture		
Hrs/wk	2		
CP	4		
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	Signals and systems		
	 Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control 		
	System type and steady-state error, error constants		
	Internal model principle		
	Root locus techniques		
	 Root locus plots Root locus design of PID controllers		
	Frequency response techniques		
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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	urse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
		Tree		CD
Title Fundamentals of Machine Tools (LC	689)	Typ Lecture	Hrs/wk 2	CP 2
Fundamentals of Machine Tools (L1992)		Recitation Section (large)	1	1
Forming and Cutting Technology (L0613)		Lecture	2	2
Forming and Cutting Technology (L0614) Recitation Section (large) 1 1		1		
Module Responsible	Prof. Wolfgang Hintze			
Admission Requirements	None			
Recommended Previous	without major course assessment			
Knowledge	internship recommended			
	Previous knowledge in mathematics, mechanics and e	ectrical engineering		
	After taking part successfully, students have reached	the following learning results		
Professional Competence	Students are able to			
Knowledge	Students are able to			
	 explain the basics of chip formation and mecha 	nisms and models of machining.		
	 explain methods and parameters for design an 	d analysis of metal forming, machining	processes and too	ols.
	 explain technical concepts of machine tool buil 			
	 explain types, constructions and functions of C 	NC-machines and give an overview on n	nulti-machine sys	tems.
	 explain equipment components. 			
Skills	Students are able to			
	 select tool geometry, cutting materials, proce 	ss parameters and appropriate measur	ing technique in	accordance with th
	requirements.			
	 estimate occurring forces and temperatures du 	ring chip formation.		
	 select appropriate machine tools for machining 	and create NC programs for turning an	d milling.	
	 assess the quality of a machine tools and to de 	tect weak points.		
Personal Competence				
Social Competence	Students are able to			
	 develop solutions in a production environment 	with gualified personnel at technical lev	al and represent	decisions
	• develop solutions in a production environment	with qualified personnel at technical lev	er und represent	decisions.
Autonomy	Students are able to			
, accitotity				
	interpret independently cutting processes.			
	 create independently NC programs. coloct independently machine tools by reference 	o to appropriato requiremente		
	 select independently machine tools by reference assess own strengths and weaknesses in gene 			
	 assess own strengths and weathesses in gene assess their learning progress and define gaps 			
	 assess possible consequences of their actions. 			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement				
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Mechanical Eng	ineering, Focus P	Product Developme
Following Curricula	and Production: Compulsory			
	General Engineering Science (English program, 7 se	mester): Specialisation Mechanical Eng	ineering, Focus P	roduct Developme
	and Production: Compulsory			
	Mechanical Engineering: Specialisation Product Devel			
	Product Development, Materials and Production: Tech	nical Complementary Course Core Stud	les: Elective Com	pulsory

Course L0689: Fundamentals	of Machine Tools
Typ	Lecture
Hrs/wk	
CP	
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Schüppstuhl
Language	DE
Cycle	WiSe
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	
	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
	weck, Manneu, Brecher, Christian Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität
	ISBN: 3540225056
	Berlin [u.a.]: Springer, 2006
	Denni Lu.a.j. Springer, 2000

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

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

Courses				
Title		Тур	Hrs/wk	СР
Computer Engineering (L0321)		Lecture	3	4
Computer Engineering (L0324)		Recitation Section (small)	1	2
Module Responsible	Prof. Heiko Falk			
Admission Requirements	None			
Recommended Previous	Basic knowledge in electrical engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence	This module deals with the foundations of the fou			
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, Sequential logic: Flip-flops, automata, system Technological foundations Computer arithmetic: Integer addition, subtra Basics of computer architecture: Programmin Memories: Memory hierarchies, SRAM, DRAM 	natic hardware design action, multiplication and division ng models, MIPS single-cycle architecture, 1, caches	pipelining	
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 compute system and the software executed on it. In particular, they shall understand the consequences that the execution of software hon the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the software completed to evaluate the processor is a specific and the software complete to evaluate the software completes from the assembly language down to gates. This way, they will be enabled to evaluate the complete to evaluate the complete to evaluate the complete to evaluate the complete to evaluate the evaluate the evaluate the to evaluate the evaluate the to evaluate the evaluat			
Personal Competence	the impact that these low abstraction levels have o			
-	Students are able to solve similar problems alone c	r in a group and to present the results acc	ordinaly.	
	Students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 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	5 5 7 7 5 7			
Following Curricula	General Engineering Science (German program, 7 s			
	General Engineering Science (German program, 7 s			
	General Engineering Science (German program,	, / semester): Specialisation Mechanica	al Engineering,	Focus Mechatro
	Compulsory General Engineering Science (German program,	7 semester): Specialization Mechanical	Engineering For	us Aircraft Syst
	Engineering: Compulsory	7 semester). Specialisation Mechanical	Engineering, Foo	us Anciait Syst
	General Engineering Science (German program, 7 s	semester): Specialisation Mechanical Engli	neering Focus Th	eoretical Mechai
	Engineering: Compulsory		icening, i occo i i	
	General Engineering Science (German program	, 7 semester): Specialisation Mechanic	al Engineering,	Focus Material
	Engineering Sciences: Compulsory	, 7 semester): Specialisation Mechanic	al Engineering,	Focus Material
	5 5		5 5.	
	Engineering Sciences: Compulsory		5 5.	
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program,	semester): Specialisation Mechanical Eng	ineering, Focus F	Product Developr
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical	ineering, Focus F Engineering, Foc	Product Developr us Energy Syste
	Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program,	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical	ineering, Focus F Engineering, Foc	Product Developr us Energy Syste
	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 Scomputer Science: Core qualification: Compulsory	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica semester): Specialisation Naval Architectur semester): Specialisation Biomedical Engin semester): Specialisation Energy and Envir semester): Specialisation Bioprocess Engin semester): Specialisation Electrical Engined	ineering, Focus F Engineering, Foc I Engineering, Foc eering: Compulsory eering: Compulso omental Enginee eering: Compulso	Product Developr us Energy Syste Focus Biomechai pry ring: Compulsory pry
	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 Gomputer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulsor	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica semester): Specialisation Naval Architectur semester): Specialisation Biomedical Engin semester): Specialisation Energy and Envir semester): Specialisation Energy and Envir semester): Specialisation Electrical Engine semester): Specialisation Electrical Engine	ineering, Focus F Engineering, Foc I Engineering, Foc eering: Compulsory eering: Compulso omental Enginee eering: Compulso	Product Developr us Energy Syste Focus Biomechai pry ring: Compulsory pry
	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 Scomputer Science: Core qualification: Compulsory	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Naval Architectur emester): Specialisation Biomedical Engin emester): Specialisation Energy and Envir emester): Specialisation Electrical Engine emester): Specialisation Electrical Engine emester): Specialisation Electrical Engine ency	ineering, Focus F Engineering, Foc I Engineering, Foc I Engineering, F re: Compulsory eering: Compulsor ering: Compulsor Compulsory	Product Developr us Energy Syste Focus Biomechau pry ring: Compulsory pry
	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 Computer Science: Core qualification: Compulsory Data Science: Core qualification: Elective Compulso Electrical Engineering: Core qualification: Compulso	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Naval Architectur emester): Specialisation Biomedical Engin emester): Specialisation Energy and Envir emester): Specialisation Electrical Engine emester): Specialisation Electrical Engine emester): Specialisation Electrical Engine ency	ineering, Focus F Engineering, Foc I Engineering, Foc I Engineering, F re: Compulsory eering: Compulsor ering: Compulsor Compulsory	Product Developr us Energy Syste Focus Biomechau pry ring: Compulsory pry
	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: Core qualification: Compulso Electrical Engineering Science (English program, 7 General Engineering Science (English program,	semester): Specialisation Mechanical Eng 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanica emester): Specialisation Naval Architectur emester): Specialisation Biomedical Engin emester): Specialisation Energy and Envir emester): Specialisation Electrical Engine emester): Specialisation Electrical Engine emester): Specialisation Electrical Engine envir emester): Specialisation Civil Engineering: 7 semester): Specialisation Mechanica	ineering, Focus F Engineering, Foc I Engineering, Foc I Engineering, F re: Compulsory eering: Compulsor ering: Compulsory Compulsory I Engineering, F	Product Developr us Energy Syste Focus Biomechau pry ring: Compulsory pry y

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. 	

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 M0599: Integ	rated Product Developme	ent and Lightweig	ht Design		
Courses					
Title CAE-Team Project (L0271) Development of Lightweight Design	Products (L0270)		Typ Project-/problem-based Learning Lecture	Hrs/wk 2 2	CP 2 2
Integrated Product Development I			Lecture	2	2
Module Responsible	Prof. Dieter Krause				
Admission Requirements	None				
	Advanced Knowledge about enginee	ering design:			
Knowledge	Fundamentals of Mechanical Engine	ering Design			
	Mechanical Engineering: Design				
	Advanced Mechanical Engineering D	Design			
Educational Objectives	After taking part successfully, stude	nts have reached the follow	wing learning results		
Professional Competence					
Knowledge	After completing the module, studer	nts are capable of:			
	 explaining the functional prin describing the interaction of t		PDM- and FEM-Systems in the product development proces	55	
Skills					
	After completing the module, studer	nts are able to:			
	product structuring		is to the desired requirements su	ich as classific	ation schemes and
Personal Competence					
	After completing the module, studer	nts are able to:			
Social competence	Arter completing the module, stude				
	 To develop a project plan and allocate work appropriate work packages in the framework of group discussions Present project results as a team for instance in a presentation 				
Autonomy	Students are capable of:				
	 independently adapt to a CAE 	E-Tool and complete a give	n practical task with it		
Workload in Hours	Indonondont Study Time 06 Study	Time in Lecture 94			
Credit points	Independent Study Time 96, Study 7 6	Time in Lecture 84			
Course achievement		Description			
		eoretical andCAE-Teamp	orojekt inkl. Vortrag und Ausarbeit	ung	
	practical wor	'k			
Examination	Written exam				
Examination duration and	90				
scale					
Assignment for the	General Engineering Science (Gen Engineering: Compulsory	man program, / semeste	r): Specialisation Mechanical Eng	jineering, Focu	is Aircraft Systems
Following Curricula	General Engineering Science (Germ	an program 7 semester).	Specialisation Mechanical Engine	erina Focus Pr	oduct Development
	and Production: Compulsory	ian program, 7 semestery.	Specialisation meenamear Engine	ening, rocus rr	
	Engineering Science: Specialisation	Mechanical Engineering: E	lective Compulsory		
	General Engineering Science (Eng	lish program, 7 semester	r): Specialisation Mechanical Eng	ineering, Focu	s Aircraft Systems
	Engineering: Compulsory				
	General Engineering Science (Englis	sh program, 7 semester):	Specialisation Mechanical Engine	ering, Focus Pr	oduct Development
	and Production: Compulsory				
	General Engineering Science (Englis			ng: Elective Co	mpulsory
	Mechanical Engineering: Specialisat Mechanical Engineering: Specialisat				
	Product Development, Materials and			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	ecture			
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 Product Development I			
Тур	ecture		
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 M1005: Enhar	nced Fundamentals of Materials	s Science			
Courses					
Title Enhanced Fundamentals: Ceramics Enhanced Fundamentals: Ceramics	-		Typ Lecture Recitation Section (large)	Hrs/wk 2 1	CP 2 1
Enhanced Fundamentals: Metals (L	1086)		Lecture	2	3
Module Responsible	Prof. Gerold Schneider				
Admission Requirements	None				
Recommended Previous Knowledge	Module "Fundamentals of Materials Science" Module "Materials Science Laboratory"				
	Module "Advanced Materials"				
Educational Objectives	After taking part successfully, students have r	reached the following	ng learning results		
Professional Competence					
Knowledge	The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects , electrical and mass transport microstructure and phase diagrams. They are capable to explain the corresponding technical terms.				
	The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects.				
Personal Competence					
Social Competence Autonomy	The students are capable to understand indep be able to critally evaluate the profoundness of		ture and propeties of ceram	ics, metals and p	olymers. They shoul
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70			
Credit points					
	None				
Examination	Written exam				
Examination duration and scale	180 min				
Assignment for the	General Engineering Science (German pro	ogram, 7 semeste	r): Specialisation Mechanic	cal Engineering,	Focus Materials
-	Engineering Sciences: Compulsory				
	Data Science: Core qualification: Elective Com General Engineering Science (English progran Sciences: Compulsory General Engineering Science (English progran and Production: Compulsory Mechanical Engineering: Specialisation Materi	m, 7 semester): Spe m, 7 semester): Sp	ecialisation Mechanical Eng	-	-
	Technomathematics: Specialisation III. Engine				

Course L1233: Enhanced Fur	idamentals: Ceramics and Polymers
Тур	Lecture
Hrs/wk	
CP	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
	Prof. Gerold Schneider, Prof. Robert Meißner
Language	
Cycle	
-	1. Einführung
	Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von Hochleistungskeramik
	2. Pulverherstellung Einteilung der Pulversyntheseverfahren
	Der Bayer-Prozess zur Al2O3-Herstellung
	Der Acheson-Prozess zur SiC-Herstellung
	Chemical Vapour Deposition
	Dub constituents
	Pulveraufbereitung
	Mahltechnik
	Sprühtrockner
	3. Formgebung
	5. ronngebung
	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	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Gerold Schneider, Prof. Robert Meißner	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1086: Enhanced Fun	ndamentals: Metals		
Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Jörg Weißmüller		
Language			
Cycle			
Content	Advanced understanding of metals:		
	Physical materials properties Materials behaviour electric thermal electrical		
	o Materials behaviour - elastic, thermal, electrical		
	 Superelasticity and shape memory effect Superelasticity and shape memory effect 		
	 Fundamentals of electrical conductivity in metals and semiconductors 		
	Superconductivity Chemical (or "dry") corrosion		
	chemical (or ally consistent		
	Driving forces and mechanisms		
	o Passivation o Growth laws		
	Introduction to electrochemistry o Electrolytes		
	o Electrolytes o lons		
	o Solvatation		
	o Dissolution and deposition of metals		
	o Galvanic cells and cell voltage		
	o Galvanic cens and cen voltage		
	o Nernst equation		
	o Polarizable electrodes		
	o Electrochemical double layer		
	 Capacitive and pseudocapacitive processes 		
	 Capacitive and pacadecipacitive 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		
	o Requirements for storage materials		
	o State of the art		
	Magnetism and magnetic materials		
	o Phenomenology: magnetic field and magnetization		
	o Para-, ferro-, antiferromagnets; Curie transition		
	o 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

Typ Hrs/wk CP Recitation Section (small) 2 3 Lecture 3 3
Recitation Section (small) 2 3 Lecture 3 3 3 h lhl dge of Mathematics and Business art successfully, students have reached the following learning results art successfully, students have reached the following learning results his module, students know the important basics of many different areas in Business and Management, from Pla ion to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to the differences between Economics and Management and the sub-disciplines in Management and to ant definitions from the field of Management the most important aspects of and goals in Management and name the most important aspects of entrepro- s e and explain basic business functions as production, procurement and sourcing, supply chain management ation and human ressource management, information management, innovation management and marketing the relevance of planning and decision making in Business, esp. in situations under multiple objectives ainty, and explain some basic methods from mathematical Finance asics from accounting and costing and selected controlling methods. able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to reneurship project in a team. In particular, they are able to a Management goals and structure them appropriately a organisational and staff structures of companies
h Ihl Ige of Mathematics and Business art successfully, students have reached the following learning results his module, students know the important basics of many different areas in Business and Management, from Pla ion to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to the differences between Economics and Management and the sub-disciplines in Management and to ant definitions from the field of Management the most important aspects of and goals in Management and name the most important aspects of entreprn s e and explain basic business functions as production, procurement and sourcing, supply chain managen ation and human ressource management, information management, innovation management and marketing the relevance of planning and decision making in Business, esp. in situations under multiple objectives inty, and explain some basic methods from mathematical Finance asics from accounting and costing and selected controlling methods. able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to reneurship project in a team. In particular, they are able to a Management goals and structure them appropriately e organisational and staff structures of companies
Ige of Mathematics and Business art successfully, students have reached the following learning results his module, students know the important basics of many different areas in Business and Management, from Pla ion to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to the differences between Economics and Management and the sub-disciplines in Management and to ant definitions from the field of Management the most important aspects of and goals in Management and name the most important aspects of entreprn s e and explain basic business functions as production, procurement and sourcing, supply chain manager ation and human ressource management, information management, innovation management and marketing the relevance of planning and decision making in Business, esp. in situations under multiple objectives ainty, and explain some basic methods from mathematical Finance asics from accounting and costing and selected controlling methods. able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to reneurship project in a team. In particular, they are able to a Management goals and structure them appropriately a organisational and staff structures of companies
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e Management goals and structure them appropriately e organisational and staff structures of companies
organisational and staff structures of companies
nethods for decision making under multiple objectives, under uncertainty and under risk
e production and procurement systems and Business information systems
e and apply basic methods of marketing
and apply basic methods from mathematical finance to predefined problems asic methods from accounting, costing and controlling to predefined problems
able to
iccessfully in a team of students y their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project municate appropriately and ierate respectfully with their fellow students. able to
a team and to organize the team themselves e a report on their project.
Study Time 110, Study Time in Lecture 70
etical and practical work
n exams during the semester
eering Science (German program, 7 semester): Core qualification: Compulsory
ironmental Engineering: Specialisation Civil Engineering: Elective Compulsory
ironmental Engineering: Specialisation Water and Environment: Elective Compulsory
ironmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory
gineering: Core qualification: Compulsory ence: Core qualification: Compulsory
Core qualification: Compulsory
Core qualification: Compulsory ineering: Core qualification: Compulsory
nvironmental Engineering: Core qualification: Compulsory
eering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
eering Science (English program, 7 semester). Specialisation Electrical Engineering: Compulsory
eering Science (English program, 7 semester). Specialisation Civit Engineering. Compulsory
eering Science (English program, 7 semester). Specialisation Bioprocess Engineering, compulsory eering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
eering Science (English program, 7 semester). Specialisation Energy and Environmental Englineering. Compulsory
neering Science (English program, 7 semester): Specialisation Computer Science. Computering, Focus Biomechi neering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechi
neering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Sys
neering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys
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
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 busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.
Litoratura	Relevante Literatur aus der korrespondierenden Vorlesung.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction t	o Management
Тур	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona
Language	DE
Cycle	WiSe/SoSe
Content	 Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management. Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, 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.

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 Engineering De			
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
		Rectation Section (large)	2	1
Module Responsible Admission Requirements				
Recommended Previous				
Knowledge	 Eundamentals of Mechanical Engineering) Design		
j-	Mechanics			
	Fundamentals of Materials Science			
	Production Engineering			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
	After passing the module, students are able to:			
		functions of machine elements and of basic		
		application scenarios and practical example	es of complex machi	ine elements,
	 indicate the background of dimensioning 	calculations.		
Skills	After passing the module, students are able to:			
	accomplish dimensioning calculations of	covorod machine elemente		
		le to new requirements and tasks (problem	colving skills)	
	 recognize the content of technical drawing 		SOIVING SKIIIS),	
	 evaluate complex designs, technically. 	igs and schematic sketches,		
	e evaluate complex designs, teennically.			
Personal Competence				
Social Competence	 Students are able to discuss technical in 	formation in the lecture supported by activa	ating methods	
		formation in the lecture supported by active	and methods.	
Autonomy	. Students are able to independently deer	on their acquired knowledge in exercises		
	 Students are able to independently deep Students are able to acquire additional 	knowledge and to recapitulate poorly und	erstood content e o	hy using the vid
	recordings of the lectures.	knowledge and to recapitulate poorly und	erstood content e.g	J. by using the via
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Course achievement		None		
Examination	Written exam	Written exam		
Examination duration and	120			
scale				
	General Engineering Science (German program			
Following Curricula	General Engineering Science (German progr	am, 7 semester): Specialisation Mechan	iical Engineering, F	Focus Biomechani
	Compulsory	7 comostor), Specialization Mechanic	al Engineering For	Suc Enorgy System
	General Engineering Science (German progra Compulsory	ini, / semester). specialisation Mechanic	ai Engineering, Foc	us Energy System
	General Engineering Science (German progra	am. 7 semester): Specialisation Mechanic	al Engineering For	cus Aircraft Sveter
	Engineering: Compulsory	, · · · · · · · · · · · · · · · · ·		
	General Engineering Science (German prog	iram. 7 semester): Specialisation Mecha	anical Engineering.	Focus Materials
	Engineering Sciences: Compulsory		597	
	General Engineering Science (German prog	ram, 7 semester): Specialisation Mechar	nical Engineering,	Focus Mechatroni
	Compulsory			
	General Engineering Science (German program	n, 7 semester): Specialisation Mechanical E	Engineering, Focus F	Product Developme
	and Production: Compulsory			
	General Engineering Science (German program	ı, 7 semester): Specialisation Mechanical Er	ngineering, Focus Th	neoretical Mechani
	Engineering: Compulsory	urse Core Studies: Elective Compulsory		
	Energy Systems: Technical Complementary Con			
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical			
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program,	7 semester): Specialisation Mechanical Eng		
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English program)	7 semester): Specialisation Mechanical Eng		
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English program) Compulsory	7 semester): Specialisation Mechanical Eng am, 7 semester): Specialisation Mechan	ical Engineering, F	Focus Biomechanie
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English progra Compulsory General Engineering Science (English progra	7 semester): Specialisation Mechanical Eng am, 7 semester): Specialisation Mechan	ical Engineering, F	Focus Biomechanie
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory	7 semester): Specialisation Mechanical Eng am, 7 semester): Specialisation Mechan m, 7 semester): Specialisation Mechanica	ical Engineering, F al Engineering, Foc	Focus Biomechanie us Energy Systen
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory General Engineering Science (English progra	7 semester): Specialisation Mechanical Eng am, 7 semester): Specialisation Mechan m, 7 semester): Specialisation Mechanica	ical Engineering, F al Engineering, Foc	Focus Biomechanie us Energy Systen
	Energy Systems: Technical Complementary Con Engineering Science: Specialisation Mechanical General Engineering Science (English program, General Engineering Science (English progra Compulsory General Engineering Science (English progra Compulsory	7 semester): Specialisation Mechanical Eng am, 7 semester): Specialisation Mechan m, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanica	ical Engineering, F al Engineering, Foc al Engineering, Foc	Focus Biomechani sus Energy Systen sus Aircraft Syster

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
	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
	 Sliding bearings Calculations of hydrostatic systems (fluidics)
	• Calculations of hydrostatic systems (hudres)
Literature	Debbal Tarakashash ("a dag Maashiganhas, Casha K. U. Faldharan, J. (Usan). Casimaan (adag aldasil), Asfland
	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
	 Maschineheremente - Gestaltung, Berechnung, Anwendung, Haberhauer, H., Bouenstein, F., Springer-verlag, aktuelik Auflage.
	 Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage.
	Sowie weitere Bücher zu speziellen Themen

Course L0265: Advanced 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

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

Course 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				
litle		Turn	Hrs/wk	СР
Signals and Systems (L0432)		Typ Lecture	3	4
Signals and Systems (L0433)		Recitation Section (small)	2	2
Module Responsible	Prof. Gerhard Bauch			
Admission Requirements	None			
Recommended Previous	Mathematics 1-3			
Knowledge		and a state of the		
	The modul is an introduction to the theory of si 1-3 is expected. Further experience with spec		-	
	but not required.		ansionn, Laplace	
	bat not required.			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	The students are able to classify and describe	signals and linear time-invariant (LTI) systems	s using methods o	of signal and syst
	theory. They are able to apply the fundament		-	-
	can describe and analyse deterministic signal			
	understand the effects in time domain and in discrete-time signal.	hage domain which are caused by the trans	ition of a continu	ous-time signai
Skills	The students are able to describe and analyse	deterministic signals and linear time-invariant	systems using m	ethods of signal
SKIIS	system theory. They can analyse and desig	-		-
	response, stability, linearity etc They can asse			
Personal Competence				
Social Competence	The students can jointly solve specific problem	s.		
Autonomy	The students are able to acquire relevant i	nformation from appropriate literature sour	ces. They can c	ontrol their leve
	knowledge during the lecture period by solving	tutorial problems, software tools, clicker syste	em.	
Workload in Hours	Independent Study Time 110, Study Time in Le	octure 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
	General Engineering Science (German program			
Following Curricula	Computer Science: Core qualification: Compuls	ory		
	Data Science: Core qualification: Compulsory			
	Electrical Engineering: Core qualification: Comp General Engineering Science (English program		ring, Compulsory	
	General Engineering Science (English program, General Engineering Science (English program,			
	General Engineering Science (English program			y
	General Engineering Science (English progr			ocus Biomechar
	Compulsory			
	General Engineering Science (English progra	m, 7 semester): Specialisation Mechanical	Engineering, Foc	us Energy Syste
	Compulsory			
	General Engineering Science (English progra	m, 7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	Engineering: Compulsory			
	General Engineering Science (English program Sciences: Compulsory	, 7 semester): Specialisation Mechanical Engin	eering, Focus Mat	teriais in Enginee
	General Engineering Science (English progr	am 7 semester): Specialisation Mechanica	al Engineering F	Focus Mechatror
	Compulsory		i Ligineenig, i	
	General Engineering Science (English program	, 7 semester): Specialisation Mechanical Engi	neering, Focus Th	eoretical Mechar
	Engineering: Compulsory			
	General Engineering Science (English program	7 semester): Specialisation Process Engineer	ng: Compulsory	
	General Engineering Science (English program		eering: Compulso	ry
	Computational Science and Engineering: Core	qualification: Compulsory		
	Mechatronics: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Enginee			

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

Courses				
Title		Тур	Hrs/wk	СР
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 and	electrical engineering		
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	Students are able to describe methods and calc	ulations for design, modeling, simulation an	d optimization of n	nechatronic systen
CL:III-	Chudente en able te angle madente dans also sitteres f	The second s		
SKIIIS	Students are able to apply modern algorithms f		an identify, simula	ite and design sim
	systems and implement those in laboratory con	ditions.		
Personal Competence				
Social Competence	Students are able to work goal-oriented in smal	mixed groups and present results to target	groups.	
Autonomy	Students are able to recognize and improve kno	wledge deficits independently.		
	With instructor assistance, students are able to	evaluate their own knowledge level and def	ine a further cours	e 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 En	aineerina. Focus M	lechatronics: Elect
Following Curricula			5 5,	
, , , , , , , , , , , , , , , , , , ,	General Engineering Science (German progra	m, 7 semester): Specialisation Mechanica	I Engineering, Fo	cus Aircraft Syster
	Engineering: Elective Compulsory			-
	Digital Mechanical Engineering: Core qualification	on: Compulsory		
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Eng	jineering, Focus Tl	neoretical Mechani
	Engineering: Elective Compulsory			
	General Engineering Science (English program	n, 7 semester): Specialisation Mechanica	Engineering, For	cus Aircraft Syste
	Engineering: Elective Compulsory			
	General Engineering Science (English program,	7 semester): Specialisation Mechanical Eng	gineering, Focus M	lechatronics: Elect
	Compulsory			
	Mechanical Engineering: Specialisation Theoret		lsory	
	Mechanical Engineering: Specialisation Aircraft			
	Mechanical Engineering: Specialisation Aircraft			
	Mechanical Engineering: Specialisation Mechatr			
	Mechanical Engineering: Specialisation Mechatr	onics: Elective Compulsory		
	Mechatronics: Core qualification: Compulsory			

Course L1822: Simulation an	Course L1822: Simulation and Design of Mechatronic Systems	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	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	nd 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
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	NN

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

Module M0725: Produ	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	internship recommended			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
-	Students are able to			
	 name basic criteria for the selection of manufaction 	turing processes.		
	 name the main groups of Manufacturing Technol 			
	 name the application areas of different manufactories 			
	 name boundaries, advantages and disadvantage 			
	 describe elements, geometric properties and kin 		tools, workpiece	and process.
	 explain the essential models of manufacturing t 	echnology.		
Skills	Students are able to			
	 select manufacturing processes in accordance v 	with the requirements		
			a component to h	a producod
	 design manufacturing processes for simple task 		e component to t	e produced.
	 assess components in terms of their production 	onented construction.		
Personal Competence				
Social Competence	Students are able to			
	 develop solutions in a production environment v 	vith qualified personnel at technical lev	el and represent	decisions.
Autonomy	Students are able to			
	 interpret independently the manufacturing proc 	ess.		
	 assess own strengths and weaknesses in generation 	al.		
	 assess their learning progress and define gaps 	to be improved.		
	 assess possible consequences of their actions. 			
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
	-			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanical Eng	ineering, Focus P	roduct Development
Following Curricula	and Production: Compulsory			
	General Engineering Science (German program, 7 sem	nester): Specialisation Mechanical Engir	neering, Focus Th	eoretical Mechanica
	Engineering: Elective Compulsory			
	Digital Mechanical Engineering: Core qualification: Cor	npulsory		
	Engineering Science: Specialisation Mechanical Engine	ering: Compulsory		
	General Engineering Science (English program, 7 seme	ester): Specialisation Mechanical Engine	eering: Compulso	ry
	General Engineering Science (English program, 7 sem	ester): Specialisation Mechanical Engir	eering, Focus Th	eoretical Mechanica
	Engineering: Elective Compulsory			
	Green Technologies: Energy, Water, Climate: Specialis	ation Energy Technology: Elective Com	pulsory	
	Logistics and Mobility: Specialisation Production Manag		-	
	Logistics and Mobility: Specialisation Engineering Scier			
	Mechanical Engineering: Core qualification: Compulsor			
	Mechatronics: Core qualification: Compulsory	-		
	Engineering and Management - Major in Logistics and	Mobility: Specialisation Production Man	agement and Pro	cesses: Compulsory
			-	. ,

Course L0608: Production En	igineering I
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze
Language	DE
Cycle	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 Er	igineering II
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wolfgang Hintze, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	 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	Typ Hrs/wk CP
Advanced Mechanical Design Proje	
Module Responsible	
Admission Requirements	
Recommended Previous	
Knowledge	Mechanical Engineering: Design
	Advanced Mechanical Engineering Design
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
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.
CL:II-	
SKIIIS	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:
	• 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	6
Course achievement	Compulsory Bonus Form Description
	Yes None Attestation
	Written exam
Examination duration and	180
scale	Control Englanding Colours (Company and Transitive) Controlinging Machanical Englanding Francesco Marcell Control
•	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory
ronowing curricula	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
	Mechanical Engineering: Core qualification: Compulsory

rse L0266: Advanced Med	hanical Design Project	
Тур	Project-/problem-based Learning	
Hrs/wk		
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Dr. Jens Schmidt, Dr. Volkert Wollesen	
Language	DE	
Cycle	WiSe	
Content	Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung.	
	Getriebekonstruktion in Einzelarbeit	
	Erarbeitung von Lösungsprinzipien	
	Berechnung von Maschinenelementen	
	 Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten 	
	Erstellung einer ausführlichen Dokumentation	
	Lösungsfindung	
	 Methodische Erarbeitung von prinzipiellen Lösungskonzepten 	
	Erstellen einer Dokumentation	
Literature	 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	

Courses				
Title		Тур	Hrs/wk	СР
ntroduction to Control Systems (LC	554)	Lecture	2	4
ntroduction to Control Systems (LC	555)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
	Representation of signals and systems in time and freque	ency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence		rononing rearing repairs		
Knowledge				
	Students can represent dynamic system behavior first and second order systems	in time and frequency domain, and	can in particular	explain properties
	first and second order systemsThey can explain the dynamics of simple control le	oops and interpret dynamic propertie	es in terms of free	quency response a
	root locus			
	• They can explain the Nyquist stability criterion and	the stability margins derived from it	t.	
	They can explain the role of the phase margin in a	nalysis and synthesis of control loops	5	
	• They can explain the way a PID controller affects a			
	 They can explain issues arising when controllers d 	esigned in continuous time domain a	re implemented	digitally
Skills				
	 Students can transform models of linear dynamic They can simulate and assess the behavior of systematics 		ain and vice vers	a
	 They can simulate and assess the behavior of syst They can design PID controllers with the help of he 			
	 They can analyze and synthesize simple control lo 			e techniques
	They can calculate discrete-time approximatio	ns of controllers designed in con	tinuous-time an	d use it for digi
	implementation			
	They can use standard software tools (Matlab Con	trol Toolbox, Simulink) for carrying ou	ut these tasks	
Personal Competence				
	Students can work in small groups to jointly solve technic	al problems, and experimentally vali	idate their contro	oller designs
Autonomy	Students can obtain information from provided sources	(lecture notes, software document	ation, experimen	t guides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-line tests	and thereby control their learning pro	aress	
	They can assess their knowledge in weekly on-line tests	and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests	and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line tests	and thereby control their learning pro	ogress.	
		and thereby control their learning pro	ogress.	
	Independent Study Time 124, Study Time in Lecture 56	and thereby control their learning pro	ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56 6	and thereby control their learning pro	ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 56 6 None	and thereby control their learning pro	ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	and thereby control their learning pro	ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam	and thereby control their learning pro	ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min		ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes		bgress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min	ter): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory	ter): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathem	ter): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathem Data Science: Core qualification: Elective Compulsory	ter): Core qualification: Compulsory natics: Elective Compulsory	ogress.	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathem Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificatio General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest	ter): Core qualification: Compulsory natics: Elective Compulsory n: Compulsory er): Specialisation Electrical Engineer er): Specialisation Civil Engineering: er): Specialisation Bioprocess Engine er): Specialisation Energy and Enviro	ring: Compulsory Compulsory ering: Compulsoi mental Engineer	ry
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathem Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificatio General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest	ter): Core qualification: Compulsory natics: Elective Compulsory er): Specialisation Electrical Engineer er): Specialisation Electrical Engineer er): Specialisation Civil Engineering: er): Specialisation Bioprocess Engine er): Specialisation Energy and Enviro er): Specialisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineer : Compulsory	ry ing: Compulsory
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Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathem Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificatio General Engineering Science (English program, 7 semest General Engineering Science (English program)	ter): Core qualification: Compulsory natics: Elective Compulsory er): Specialisation Electrical Engineer er): Specialisation Electrical Engineer er): Specialisation Civil Engineering: er): Specialisation Bioprocess Engine er): Specialisation Bioprocess Engine er): Specialisation Energy and Enviro er): Specialisation Computer Science ermester): Specialisation Mechanical	ring: Compulsory Compulsory ering: Compulsor mental Engineer : Compulsory I Engineering, F	ry ing: Compulsory Focus Biomechanic
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mather Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificatio General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 se Compulsory General Engineering Science (English program, 7 se	ter): Core qualification: Compulsory natics: Elective Compulsory er): Specialisation Electrical Engineer er): Specialisation Electrical Engineer er): Specialisation Civil Engineering: er): Specialisation Bioprocess Engine er): Specialisation Bioprocess Engine er): Specialisation Denergy and Enviro er): Specialisation Computer Science emester): Specialisation Mechanical E	ring: Compulsory Compulsory ering: Compulsor mental Engineer : Compulsory I Engineering, Foc	ry ing: Compulsory Focus Biomechania us Energy System
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semes Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathem Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificatio General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 semest Compulsory General Engineering Science (English program, 7 semest Compulsory General Engineering Science (English program, 7 semest Compulsory	ter): Core qualification: Compulsory natics: Elective Compulsory er): Specialisation Electrical Engineer er): Specialisation Civil Engineering: er): Specialisation Bioprocess Engine er): Specialisation Bioprocess Engine er): Specialisation Computer Science emester): Specialisation Mechanical nester): Specialisation Mechanical E nester): Specialisation Mechanical I	ring: Compulsory Compulsory ering: Compulsor mental Engineer : Compulsory I Engineering, Foc Engineering, Foc	ry ing: Compulsory Focus Biomechanic us Energy System rus Aircraft Syster
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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 Suctors three and stoody state error, error constants
	 System type and steady-state error, error constants Internal model principle
	Root locus techniques
	Root locus plots
	Root locus design of PID controllers
	Frequency response techniques
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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 equationsTustin 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	urse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses	
Title	Typ Hrs/wk CP
Numerical Mathematics I (L0417)	Typ Hrs/wk CP Lecture 2 3
Numerical Mathematics I (L0418)	Recitation Section (small) 2 3
Module Responsible	Prof. Sabine Le Borne
Admission Requirements	
Recommended Previous	
Knowledge	
	basic MATLAB/Python knowledge
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
	Students are able to
	 name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root fin
	problems and to explain their core ideas,
	 repeat convergence statements for the numerical methods, explain accests for the practical execution of numerical methods with respect to computational and storage complexity.
	explain aspects for the practical execution of numerical methods with respect to computational and storage complexitx.
Chille	Chudanha ara abla ka
SKIIIS	Students are able to
	 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	
	Students are able to
	 work together in heterogeneously composed teams (i.e., teams from different study programs and background knowled
	explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithm
Autonomv	Students are capable
	 to assess whether the supporting theoretical and practical excercises are better solved individually or in a team,
	 to assess their individual progess and, if necessary, to ask questions and seek help.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
	Written exam
Examination duration and	
scale	
	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory
-	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Material:
· · · · · · · · · · · · · · · · · · ·	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 Mechan
	Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syst
	Engineering: Elective Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Elec
	Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste
	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 Mechanical Engineering, Focus Biomecha
	Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineer Sciences: Compulsory
	Sciences: Compulsory
	Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan
	Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan 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
СР	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	ourse L0418: Numerical Mathematics I	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sabine Le Borne, Dr. Jens-Peter Zemke	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Title Typ Hrs/wk CP Computer Engineering (L0321) Lecture 3 4 Computer Engineering (L0324) Recitation Section (small) 1 2 Module Responsible Prof. Heiko Falk Image: Section (small) 1 2 Admission Requirements None Image: Section (small) 1 2 Recommended Previous Basic knowledge in electrical engineering Knowledge Image: Section Section (small) 1 2 Professional Competence Knowledge in electrical engineering Image: Section Section (small) 1 2 Knowledge This module deals with the foundations of the functionality of computing systems. It covers the layers from the assemb 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<th>Courses</th><th></th><th></th><th></th><th></th>	Courses				
	Title		Түр	Hrs/wk	СР
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Revertees Control Executional Competence This module data suth the foundations of the functionality of computing systems. It covers the layers from the assemble programming down to gates. The module incluses the failowing inpose. In the inclusion of the functionality of computing systems. It covers the layers from the assemble programming down to gates. The module incluses the failowing inpose. In the inclusion of the inclusion of the functionality of computing systems. It covers the layers from the assemble incluses in the inclusion of the inclusion of the inclusion of the inclusion. In the inclusion of the inclusion of the functionality of computer systems. The inclusion of the inclusion of the inclusion of the inclusion. In the inclusion of the inclusion. In the inclusion of the inclusion o	Admission Requirements	None			
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Professional Competence Xooselege The module data with the foundations of the functionality of computing systems. It covers the layers from the assemb rorgramming down to gates. The module includes the following topics: Introduction Computer attributional logic: File-fogs, submata, systematic hardware design Teamonics for computer attributions. Systematic hardware design Teamonics for computer attributions: Solid Computer attribution: Teamonics Memory hierarchies, SAAA, DRAA, Caches Teamonics Memory hierarchies, SaAAA, DRAA, Caches Teamonics Memory hierarchies, SaAAA, DRAA, Caches After successful compliation at methodule, the statistical statistic and the intervent and the computer systems. They are able to adinguith hierarchies are able to adinguith to the statistical compliant on the module, the statistical statistic compliant on the data statistical searable to judge the interdependencies between a physical co adiotan of few and simple components. They are able to divident the transaction to today's computing systems - from gates and circuits up to complete processors. After successful compliant on the module, the statistic advocum to adule. The statistical statistical searable to advocue on to advocue and the successful compliant on the module, the statistical searable to advocue on to advocue and to propose fassible options. After successful compliant on the module, the statistical searable to advocue on to advocue and to propose fassible options. After successful compliant on the module, the statistical searable and the obself searable statistical searable to advocue on the advocue on to associate this knowledge with o	-				
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	-	This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-le			
Inday'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 to system and the software-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to e the impact that these low abstraction layers from the assembly language down to gates. This way, they will be enabled to e the impact that these low abstraction layers from the assembly language down to gates. This way, they will be enabled to e the impact that these low abstraction layers from specific literature and to propose feasible options. Social Completence Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. Workload in Hourn Independent Study Time 124, Study Time in Lecture 56 Coruse achievement Commutery listums Form Description Examination Winking exam Becription Examination On minutes, contents of course and labs Eccercice Social Completer General Engineering Science (German program, 7 semester): Specialisation Chul Engineering, Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft S Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft S Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineeri	Skills	 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 			
Social Competence Students are able to solve similar problems alone or in a group and to present the results accordingly. 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 achievement General Engineering Science (German Pogram, 7 semester): Specialisation Computer Science: Compulsory Examination duration and Scale On minutes, Contents of course and labs Scale Course achievement Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Following Curricula General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft S Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft S Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft S Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mate Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Broyce (German Program, 7 semester): Specialisation Mechanical Engineering, Focus Broyce (Germal Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomec Compulsory General Engineering Science (G		After successful completion of the module, the students are able to judge the interdependencies between a physical compo- 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 evalu			
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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	

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			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students will have an overview of vario	us technical problems and the differential equat	ions, which describe	them. Students w
	gave an overview of different solution ap	proaches and for which kind of problems they ca	n be used for.	
C1:11-	Churchen and a black a solution difference be ab			
SKIIIS	Students are able to solve different technical problems with the introduced discretization methods.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop solution strategies.			
Autonomy	The students are able to develop solution	n strategies for complex problems self-consistent	and critically analyse	e results.
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	General Engineering Science (German p	rogram, 7 semester): Specialisation Mechanical E	ngineering, Focus Th	eoretical Mechanic
Following Curricula	Engineering: Compulsory			
	Engineering Science: Core qualification:	Compulsory		
	General Engineering Science (English pro	ogram, 7 semester): Core qualification: Compulso	ry	
	General Engineering Science (English pr	ogram, 7 semester): Specialisation Mechanical E	ngineering, Focus Th	eoretical Mechanic
	Engineering: Elective Compulsory			
	Mechanical Engineering: Specialisation T	heoretical Mechanical Engineering: Elective Comp	oulsory	
	Mechanical Engineering: Specialisation T	heoretical Mechanical Engineering: Compulsory		
	Technomathematics: Specialisation III. E	ngineering Science: Elective Compulsory		

Course L2446: Modeling, Simulation and Optimization			
Тур	Integrated Lecture		
Hrs/wk	1		
CP	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Benedikt Kriegesmann, Prof. Thomas Rung, Prof. Alexander Düster, Prof. Robert Seifried		
Language	EN		
Cycle	SoSe		
Content	 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.		

Courses	
	The Hardwide CD
Fitle Management Tutorial (L0882)	TypHrs/wkCPRecitation Section (small)23
ntroduction to Management (L088	
Module Responsible	Prof. Christoph Ihl
Admission Requirements	None
Recommended Previous	Basic Knowledge of Mathematics and Business
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planni and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	 explain the differences between Economics and Management and the sub-disciplines in Management and to nai important definitions from the field of Management
	• explain the most important aspects of and goals in Management and name the most important aspects of entreprneu
	projects
	describe and explain basic business functions as production, procurement and sourcing, supply chain manageme
	organization and human ressource management, information management, innovation management and marketing
	 explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives a uncertainty, and explain some basic methods from mathematical Finance
	 state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to ca out an Entrepreneurship project in a team. In particular, they are able to
	analyse Management goals and structure them appropriately
	 analyse organisational and staff structures of companies
	 apply methods for decision making under multiple objectives, under uncertainty and under risk
	 analyse production and procurement systems and Business information systems
	 analyse and apply basic methods of marketing
	select and apply basic methods from mathematical finance to predefined problems
	 apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
	work successfully in a team of students
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	 to communicate appropriately and
	 to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	 work in a team and to organize the team themselves
	to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and	several written exams during the semester
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Data Science: Core qualification: Compulsory
	Flashing Fasing and a second second second
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation 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 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 Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste

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	382: 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 busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

ndent Study Time 48, Study Time in Lecture 42 nristoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius t, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
nristoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneliu:	
nristoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius	
nristoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneliu:	
r, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona	
WiSe/SoSe	
ntroduction to Business and Management, Business versus Economics, relevant areas in Business and Management mortant definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovatio Anagement, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informatio Anagement Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. televance of marketing, B2B vs. B2C-Marketing lifferent techniques from the field of marketing (e.g. scenario technique), pricing strategies mportant organizational structures iasics of human ressource management htroduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems ielected Planning Tasks, e.g. Investment and Financial Decisions ntroduction to Accounting: Accounting, Balance-Sheets, Costing televance of Controlling and selected Controlling methods mportant aspects of Entrepreneurship projects	
rg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 hr, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003	
d, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006.	
vitz, L.: Finanzmathematik. 3. Auflage, München 2001.	
B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.	
zer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Au rt 2005.	
J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.	
rl	

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	-	Recitation Section (small)	1	1
Differential Equations 2 (Partial Dif	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038) Lecture 2 1		1		
	Complex Functions (L1041) Recitation Section (small) 1 1			
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students can name the basic concepts in Mathematics IV	. They are able to explain the	m using appropria	ate examples.
	Students can discuss logical connections between these			
	the help of examples.		j.	
	 They know proof strategies and can reproduce them. 			
Skills				
	Students can model problems in Mathematics IV with the second secon	ne help of the concepts studi	ed in this course.	Moreover, they are
	capable of solving them by applying established methods			
	 Students are able to discover and verify further logical control 			
	 For a given problem, the students can develop and ex 	ecute a suitable approach, a	nd are able to cr	itically evaluate the
	results.			
Personal Competence				
Social Competence	Students are able to work together in teams. They are ca	nable to use mathematics as	a common langua	ade
	 In doing so, they can communicate new concepts accord 			
	design examples to check and deepen the understanding		ferdanig paraters	horeover, and can
	design examples to encert and deepen the understanding	for their peers.		
Autonomy				
Autonomy	Students are capable of checking their understanding of	f complex concepts on their o	wn. They can spe	ecify open questions
	precisely and know where to get help in solving them.			
	Students have developed sufficient persistence to be a	ble to work for longer period	s in a goal-orient	ed manner on hard
	problems.			
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equations 2)			
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Sp	pecialisation Electrical Enginee	ering: Compulsory	1
Following Curricula	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanica	I Engineering, F	ocus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semester): Sp	pecialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 semester): S	pecialisation Mechanical Engir	neering, Focus Th	eoretical Mechanical
	Engineering: Elective Compulsory			
	Computer Science: Specialisation Computational Mathematics:	Elective Compulsory		
	Electrical Engineering: Core qualification: Compulsory			
	General Engineering Science (English program, 7 semester): Sp	ecialisation Electrical Enginee	ring: Compulsory	
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanica	l Engineering, F	ocus Mechatronics:
	Compulsory			
	General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanical Engir	eering, Focus Th	eoretical Mechanical
	Engineering: Compulsory			
	Computational Science and Engineering: Specialisation II. Mathe	ematics & Engineering Science	e: Elective Compu	lsory
	Mechanical Engineering: Specialisation Mechatronics: Compulso	ory		
	Mechanical Engineering: Specialisation Theoretical Mechanical E	Engineering: Elective Compuls	ory	
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Theoretical Mechanical Engineering: Technical Complementary	Course Core Studies: Elective	Compulsory	

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

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

Course L1038: Complex Functions		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dozenten des Fachbereiches Mathematik der UHH	
Language	DE	
Cycle	SoSe	
Content	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 Fund	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	

Specialization Biomedical Engineering

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

Courses				
ītle		Тур	Hrs/wk	СР
undamentals of Materials Science	e I (L1085)	Lecture	2	2
undamentals of Materials Science	e II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
hysical and Chemical Basics of M	aterials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics			
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students have acquired a fundamental knowledge on 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	mic structure, microstructor ut the key aspects of char	ure, phase diagrai acterization meth
Skill	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 microstruction 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				
Course achievement				
	Written exam			
Examination duration and				
scale				
	General Engineering Science (German program, 7 semester): S	necialisation Mechani	cal Engineering: Compulse	arv
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 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: Com	pecialisation Energy a pecialisation Naval Ar pecialisation Naval Ar	and Enviromental Engineer chitecture: Compulsory	
	General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp	pecialisation Mechanic pecialisation Naval Arc pecialisation Biomedic	al Engineering: Compulso hitecture: Compulsory al Engineering: Compulsor	ry

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	s of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider
Language	DE
Cycle	SoSe
	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 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				
Fitle		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			
	Basic knowledge in electrical engineering			
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence Knowledge	This module deals with the foundations of the funct programming down to gates. The module includes th		s the layers fron	n the assembly-le
	Introduction			
	 Combinational logic: Gates, Boolean algebra, E 	Boolean functions, hardware synthesis, co	mbinational net	works
	 Sequential logic: Flip-flops, automata, systema 			inormo
	Technological foundations	5		
	Computer arithmetic: Integer addition, subtract	ction, multiplication and division		
	Basics of computer architecture: Programming	g models, MIPS single-cycle architecture, j	pipelining	
	Memories: Memory hierarchies, SRAM, DRAM,			
	 Input/output: I/O from the perspective of the C 	CPU, principles of passing data, point-to-p	oint connections,	busses
Skills	The students perceive computer systems from the ar	rchitect's perspective, i.e., they identify the	ne internal struct	ture and the phys
	composition of computer systems. The students can	analyze, how highly specific and individu	al computers ca	n be built based o
	collection of few and simple components. They are		in the different	abstraction layer
	today's computing systems - from gates and circuits	up to complete processors.		
	After successful completion of the module, the stud	dents are able to judge the interdepend	encies between	a physical comp
	system and the software executed on it. In particula	r, they shall understand the consequence	es that the exect	ution of software
	on the hardware-centric abstraction layers from the			
	the impact that these low abstraction levels have on	an entire system's performance and to p	ropose feasible o	options.
Personal Competence				
Social Competence	Students are able to solve similar problems alone or	in a group and to present the results acco	ordingly.	
Autonomy	Students are able to acquire new knowledge from sp	ocific literature and to associate this know	wladge with othe	r classos
Autonomy	Students are able to acquire new knowledge from sp		neuge 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 Description	escription		
Examination				
Examination duration and	90 minutes, contents of course and labs			
scale				
Assignment for the	General Engineering Science (German program, 7 se	mester): Specialisation Computer Science	: Compulsory	
Following Curricula	General Engineering Science (German program, 7 se	mester): Specialisation Bioprocess Engine	ering: Compulso	ory
	General Engineering Science (German program, 7 se	mester): Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (German program, 7 se			
		mester): Specialisation Electrical Enginee	ring: Compulsory	1
	General Engineering Science (German program, 7 se	mester): Specialisation Biomedical Engine	eering: Compulso	bry
	General Engineering Science (German program, 7 se	mester): Specialisation Biomedical Engine mester): Specialisation Energy and Enviro	eering: Compulso omental Engineer	bry
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	mester): Specialisation Biomedical Engine mester): Specialisation Energy and Enviro mester): Specialisation Process Engineeri	eering: Compulso omental Engineer ng: Compulsory	ory ring: Compulsory
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se General Engineering Science (German program,	mester): Specialisation Biomedical Engine mester): Specialisation Energy and Enviro mester): Specialisation Process Engineeri	eering: Compulso omental Engineer ng: Compulsory	ory ring: Compulsory
	General Engineering Science (German program, 7 se General Engineering Science (German program, 7 se	mester): Specialisation Biomedical Engine mester): Specialisation Energy and Enviro mester): Specialisation Process Engineeri 7 semester): Specialisation Mechanica	eering: Compulso omental Engineer ng: Compulsory I Engineering, I	ring: Compulsory Focus Mechatror
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General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering
Sciences: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics:
Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development
and Production: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical
Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation II. Informatics: Elective Compulsory

Course L0321: Computer Eng	Course L0321: Computer Engineering		
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	ndependent 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
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

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Courses				
Title		Тур	Hrs/wk	СР
	al Mechanics, Numerical Mechanics) (L1137)	Lecture	3	3
	al Mechanics, Numerical Mechanics) (L1138)	Recitation Section (small)	2 1	2 1
	al Mechanics, Numerical Mechanics) (L1139)	Recitation Section (large)	I	1
Module Responsible				
Admission Requirements				
Recommended Previous Knowledge	Mathematics I-III and Mechanics I-III			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can			
	 describe the axiomatic procedure used in med available important store in model design. 	nanical contexts;		
	 explain important steps in model design; precent technical knowledge 			
	 present technical knowledge. 			
Skills	The students can			
	 explain the important elements of mathemati 	cal / mechanical analysis and model for	mation and appl	v it to the context
	their own problems;			y it to the context
	 apply basic methods to engineering problems; 			
	 estimate the reach and boundaries of the met 		o wider problem	sets.
Personal Competence				
Social Competence	The students can work in groups and support each of	her to overcome difficulties.		
Autonomy	Students are capable of determining their own streng	gths 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 8	4		
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 Engin	eering: Compuls	ory
Following Curricula				ory
	General Engineering Science (German program, 7 se	•	e: Compulsory	
	Energy Systems: Technical Complementary Course C			
	General Engineering Science (English program, 7 sen			ry
	General Engineering Science (English program, 7 sen			
	General Engineering Science (English program, 7 sen		ering: Compulso	ry
	Mechanical Engineering: Core qualification: Compulse	бгу		
	Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering S	cience: Elective Compulson		
	Theoretical Mechanical Engineering: Technical Comp	1 2	Compulsory	
	meeter rechancer Engineering, rechincal comp	contention y course core studies. Liettive	sampaisory	
Course L1137: Mechanics IV	(Oscillations, Analytical Mechanics, Numerical M	lechanics)		
Тур				
Hrs/wk	3			
CP	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 4	-		

workloau III Hours	independent study rime 48, study rime in Lecture 42
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).

Cycle SoSe Content See in

Literature

See interlocking course

See interlocking course

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

Module M0680: Fluid	Dynamics			
2				
Courses				
Title		Тур	Hrs/wk	СР
Fluid Mechanics (L0454) Fluid Mechanics (L0455)		Lecture Recitation Section (large)	3 2	4 2
		Recitation Section (large)	Z	Z
Module Responsible				
Admission Requirements				
Recommended Previous	Sound knowledge of engineering mathematics, engineer	ring mechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge to	explain the general principles of flui	id engineering a	nd physics of fluid
	Students can scientifically outline the rationale of flow	physics using mathematical models a	and are familiar v	vith methods for t
	performance analysis and the prediciton of fluid engine	ering devices.		
Skills	<i>Skills</i> Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. Th enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devi			
Skiis				
	scientific level.			
Personal Competence				
Social Competence	The students are able to discuss problems and jointly develop solution strategies.			
Autonomy	The students are able to develop solution strategies for	complex problems self-consistent and	l crtically analyse	results.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Mechanical Engin	eering: Compulso	ory
Following Curricula	General Engineering Science (German program, 7 seme	ster): Specialisation Biomedical Engin	eering: Compulso	ry
-	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: 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 Engineering Sciences: Elective Compulsory			
	Mechanical Engineering: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering Scie	nce: 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
Literature	 fundamentals of gas dynamics (1D compressible flows) 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			
Workload in Hours	pendent Study Time 32, Study Time in Lecture 28		
Lecturer	Thomas Rung		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses					
Title		Тур	Hrs/wk	СР	
Signals and Systems (L0432)		Lecture	3	4	
Signals and Systems (L0433)		Recitation Section (small)	2	2	
Module Responsible	Prof. Gerhard Bauch				
Admission Requirements	None				
Recommended Previous					
Knowledge	Mathematics 1-5				
-	The modul is an introduction to the theory of signals 1-3 is expected. Further experience with spectral tr but not required.		-		
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	The students are able to classify and describe signa theory. They are able to apply the fundamental tran can describe and analyse deterministic signals and understand the effects in time domain and image discrete-time signal.	nsformations of continuous-time and disc systems mathematically in both time a	crete-time signals and image domain	and systems. T n. In particular, t	
Skills	The students are able to describe and analyse deter system theory. They can analyse and design bas response, stability, linearity etc They can assess the	ic systems regarding important proper	rties such as ma	ignitude and ph	
Personal Competence					
Social Competence	The students can jointly solve specific problems.				
Autonomy	The students are able to acquire relevant inform knowledge during the lecture period by solving tutor			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 se	mester): 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 semester): Specialisation Electrical Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory				
	General Engineering Science (English program, 7 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 Materials in Engineeri Sciences: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronic Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanic				
	Engineering: Compulsory General Engineering Science (English program, 7 ser		-		
	General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser		5 1 5	N	
	Computational Science and Engineering: Core qualifi		compuisor	3	
	Mechatronics: Core qualification: Compulsory				

Course L0432: Signals and Systems				
Тур	cture			
Hrs/wk	3			
CP	4			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Lecturer	f. Gerhard Bauch			
Language	/EN			
Cycle	ie			
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 function
 - Crosscorrelation 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	pendent Study Time 32, Study Time in Lecture 28		
Lecturer	Gerhard Bauch		
Language	DE/EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

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; 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 acqu			
	the relevant knowledge themselves.			
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 minutes			
scale				
Assignment for the	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			
	Mechanical Engineering: Specialisation Biomechanics: Compulsory			
	Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory			
	Biomedical Engineering: Specialisation Medical rectinology and Control medic. Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory			
	Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory			

	Anatomy		
	ecture		
Hrs/wk	2		
CP			
	ndependent Study Time 62, Study Time	in Lecture 28	
	rof. Tobias Lange		
Language			
Cycle			
Content	eneral Anatomy		
	st week: The Eucaryote Cell		
	nd week: The Tissues		
	rd week: Cell Cycle, Basics i	n Development	
	+h		
	th week: Musculoskeletal Sy	stem	
	th week: Cardiovascular Sys	tem	
	th week: Respiratory System	1	
	th week: Genito-urinary Sys	tem	
	th week: Immune system		
	th week: Digestive System I		
	0 th week: Digestive System I	I	
	1 th week: Endocrine System		
	2 th week: Nervous System		
	3 th week: Exam		
Literature	dolf Faller/Michael Schünke, Der Körper	des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016	

Courses				
ritle		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, students ha	ave reached the following learning results		
Professional Competence				
Knowledge				
	The students can distinguish different type	es of currently used equipment with respect	to its use in radiation therap	oy.
	The students can explain treatment plans	used in radiation therapy in interdisciplinar	y contexts (e.g. surgery, inte	rnal medicine).
	The students can describe the patien	ts' passage from their initial admittanc	e through to follow-up ca	re.
	Diagnostics			
	5	have concerns of projection redienraphy in		
	well as sectional imaging techniques (CT,	base concepts of projection radiography, ir MRT, US).	iciuding anglography and m	ammograpny,
	The students can explain the diagnostic a techniques.	as well as therapeutic use of imaging techni	ques, as well as the technica	al basis for tho
	The students can choose the right treatme	ent method depending on the patient's clinic	cal history and needs.	
	The student can explain the influence of t	echnical errors on the imaging techniques.		
	·		with a survey pueto cal	
	The student can draw the right conclusion	is based on the images' diagnostic findings of	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 individual psychosocial service should look like (e.g. follow-up treatment, sports, social help groups, self-help groups, social services, psycho-oncology).			
	Diagnostics			
	The students can suggest solutions for reg	pairs of imaging instrumentation after havin	g done error analyses.	
	The students can classify results of imaging techniques according to different groups of diseases based on their knowledge o			
	anatomy, pathology and pathophysiology.			en knowledge
Personal Competence				
Social Competence		I situation of tumor patients and interact wit often fear-dominated behavior of sick pe		
	measures and can meet them appropriate		opic caused by alagnostic	and theraped
Autonomy	The students can apply their new knowled	due and skills to a concrete therapy case		
Hatonomy	The students can introduce younger stude			
	The students are able to access anatomic	cal knowledge by themselves, can participa	te competently in conversat	ions on the tor
	and acquire the relevant knowledge them		, , , , , , , , , , , , , , , , , , , ,	
Workload in Hours	Independent Study Time 62, Study Time i	n Lecture 28		
Credit points				
Course achievement	None			
Examination Examination duration and	Written exam			
scale	90 minutes			
Assignment for the	General Engineering Science (German pro	ogram, 7 semester): Specialisation Biomedic	al Engineering: Compulsory	
Following Curricula		program, 7 semester): Specialisation Me	chanical Engineering, Focu	s Biomechanio
	Compulsory Data Science: Specialisation Medicine: Co	mulson		
	Electrical Engineering: Specialisation Med			
	Engineering Science: Specialisation Biome	edical Engineering: Compulsory		
		program, 7 semester): Specialisation Me	chanical Engineering, Focu	s Biomechanio
	Compulsory General Engineering Science (English prog	gram, 7 semester): Specialisation Biomedica	l Engineering: Compulsorv	
		gram, 7 semester): Specialisation Biomedica		
	Mechanical Engineering: Specialisation Bio Biomedical Engineering: Specialisation Me		and Community	

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	2
СР	
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Ulrich Carl, Prof. Thomas Vestring
Language Cycle	
	The students will be given an understanding of the technological possibilities in the field of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. 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				
itle		Тур	Hrs/wk	СР
ntroduction to Biochemistry and Mo	ecular 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 h	ave 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 D 			
Skills	The students can			
	 recognize the importance of molection 	cular parameters for the course of a disease;		
	 describe selected molecular-diagn 	•		
	explain the relevance of these pro-	cedures for some diseases		
Personal Competence				
Social Competence	The students can participate in discussion	ns in research and medicine on a technical level.		
Autonomy	The students can develop understanding	of topics from the course, using technical literati	ure, by themselves.	
Workload in Hours	Independent Study Time 62, Study Time	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 pr	ogram, 7 semester): Specialisation Biomedical Er	ngineering: Compulsor	У
Following Curricula	General Engineering Science (German	program, 7 semester): Specialisation Mechan	nical Engineering, Fo	cus Biomechanie
	Compulsory			
	Data Science: Specialisation Medicine: Co	ompulsory		
	Electrical Engineering: Specialisation Med	dical Technology: Elective Compulsory		
	Engineering Science: Specialisation Biom	edical Engineering: Compulsory		
	General Engineering Science (English pro	gram, 7 semester): Specialisation Biomedical En	gineering: Compulsory	/
	General Engineering Science (English	program, 7 semester): Specialisation Mechan	nical Engineering, Fo	cus Biomechanie
	Compulsory			
	Mechanical Engineering: Specialisation B	iomechanics: Compulsory		
	Biomedical Engineering: Specialisation M	anagement and Business Administration: Elective	e Compulsory	
	Biomedical Engineering: Specialisation A	rtificial Organs and Regenerative Medicine: Electi	ive Compulsory	
	Biomedical Engineering: Specialisation M	edical Technology and Control Theory: Elective C	Compulsory	
	Biomedical Engineering: Specialisation In	nplants and Endoprostheses: Elective Compulsory	у	

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

Module M1333: BIO I:	Implants and Fracture Healing			
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 "Introduction into	Anatomie" before attending "Im	plants and Fracture Heali	ng".
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students can describe the different ways how bor	nes heal, and the requirements for	or their existence.	
	The students can name different treatments for the s	pine and hollow bones under give	en fracture morphologies	
Skills	The students can determine the forces acting within t	he human body under quasi-stat	ic situations under specif	ic assumptions.
Personal Competence				
•	The students can, in groups, solve basic numerical me	odeling tasks for the calculation (of internal forces.	
	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	3		
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 Biomechanio
Following Curricula	Compulsory			
	General Engineering Science (German program, 7 ser	nester): Specialisation Biomedica	al Engineering: Compulso	ry
	Engineering Science: Specialisation Biomedical Engine	eering: Compulsory		
	General Engineering Science (English program, 7 sem	ester): Specialisation Biomedica	l Engineering: Compulsor	У
	General Engineering Science (English program, 7	semester): Specialisation Mee	chanical Engineering, Fo	ocus Biomechani
	Compulsory			
	Mechanical Engineering: Specialisation Biomechanics	: Compulsory		
	Biomedical Engineering: Specialisation Implants and B			
	Biomedical Engineering: Specialisation Artificial Organ	ns and Regenerative Medicine: El	ective Compulsory	
	Biomedical Engineering: Specialisation Management a	and Business Administration: Elec	ctive Compulsory	
	Biomedical Engineering: Specialisation Medical Techn	ology and Control Theory: Electiv	e Compulsory	
	Orientation Studies: Core qualification: Elective Comp	ulsory		
	Technomathematics: Specialisation III. Engineering So	cience: Elective Compulsory		

Course L0376: Implants and	Fracture Healing
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Michael Morlock
Language	DE
Cycle	
Content	Topics to be covered include:
	1. Introduction (history, definitions, background importance)
	2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius)
	3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments)
	3.1 The spine in its entirety
	3.2 Cervical spine
	3.3 Thoracic spine
	3.4 Lumbar spine
	3.5 Injuries and diseases
	4. Pelvis (anatomy, biomechanics, fracture treatment)
	5 Fracture Healing
	5.1 Basics and biology of fracture repair
	5.2 Clinical principals and terminology of fracture treatment
	5.3 Biomechanics of fracture treatment
	5.3.1 Screws
	5.3.2 Plates
	5.3.3 Nails
	5.3.4 External fixation devices
	5.3.5 Spine implants
	6.0 New Implants
	Coskran V.D. Otherädische Riemechenik
	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
ntroduction to Control Systems (L0	554)	Lecture	2	4
ntroduction to Control Systems (L0	555)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
	Representation of signals and systems in time and fre	equency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
	Students can represent dynamic system behave	vior in time and frequency domain, and	can in particular	explain properties
	first and second order systemsThey can explain the dynamics of simple contr	ol loops and interpret dynamic propertie	es in terms of free	nuency response a
	root locus	or loops and interpret dynamic propertie		quency response u
	They can explain the Nyquist stability criterion	and the stability margins derived from it	t.	
	• They can explain the role of the phase margin	in analysis and synthesis of control loops	5	
	They can explain the way a PID controller affect	ts a control loop in terms of its frequenc	y response	
	 They can explain issues arising when controller 	rs designed in continuous time domain a	re implemented	digitally
Skills				
	Students can transform models of linear dynam There are simulate and access the helperior of a		ain and vice vers	a
	 They can simulate and assess the behavior of s They can design PID controllers with the help o 			
	 They can analyze and synthesize simple control 			e techniques
	They can calculate discrete-time approxima			
	implementation			
	They can use standard software tools (Matlab 0	Control Toolbox, Simulink) for carrying ou	ut these tasks	
Personal Competence				
	Students can work in small groups to jointly solve tec	hnical problems, and experimentally vali	idate their contro	ller designs
Autonomy	Students can obtain information from provided sour	ces (lecture notes, software document	ation, experimen	t guides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-line te	sts and thereby control their learning pro	ouress	
	They can assess their knowledge in weekly on-line te	sts and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line te	sts and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line te	sts and thereby control their learning pro	ogress.	
			ogress.	
	Independent Study Time 124, Study Time in Lecture 5		ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 5		ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lecture 5 6 None		ogress.	
Credit points	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam		ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam		ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min	56	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser	56 nester): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min	56 mester): Core qualification: Compulsory ry	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory	bgress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory	bgress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: A series General Engineering Science (English program, 7 series	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer	ring: Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Civil Engineering:	ring: Compulsory Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Civil Engineering: nester): Specialisation Bioprocess Engine	ring: Compulsory Compulsory ering: Compulsor	ŷ
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Civil Engineering: nester): Specialisation Bioprocess Engine nester): Specialisation Bioprocess Engine	ring: Compulsory Compulsory ering: Compulsor mental Engineeri	ŷ
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Electrical Engineer nester): Specialisation Eloprocess Engine nester): Specialisation Bioprocess Engine nester): Specialisation Energy and Enviro nester): Specialisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory	ry ing: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Electrical Engineer nester): Specialisation Eloprocess Engine nester): Specialisation Bioprocess Engine nester): Specialisation Energy and Enviro nester): Specialisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory	ry ing: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Computer Science semester): Specialisation Mechanical	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory I Engineering, F	ry ing: Compulsory focus Biomechanic
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Computer Science semester): Specialisation Mechanical	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory I Engineering, F	ry ing: Compulsory focus Biomechanic
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lecture 5 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program), 7 ser General Engineering S	56 mester): Core qualification: Compulsory ry nematics: Elective Compulsory ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Electrical Engineer nester): Specialisation Electrical Engineer nester): Specialisation Energy and Enviro nester): Specialisation Computer Science semester): Specialisation Mechanical E	ring: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory I Engineering, Foc	ry ing: Compulsory focus Biomechania us Energy System
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ĺ	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 constantsInternal 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 equationsTustin 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	urse L0655: Introduction to Control Systems	
Тур	Recitation Section (small)	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Herbert Werner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
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 areas of the students have reached the fe	llouing leaveing regults		
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence	The students are able to			
Knowledge				
	- describe the different physical mechanism of Heat Transfe	ir,		
	- explain the technical terms,			
	- to analyse comlex heat transfer processes in a critical way	<i>'</i> .		
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.			
	- solve excersises self-consistent and in small groups.			
Personal Competence				
Social Competence	The students are able to discuss in small groups and develo	p an approach.		
Autonomv	The students are able to develop a complex problem self-co	onsistent and analyse the results i	n a critical way.	A qualified exchar
	with other students is given.	, ,	,	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination				
Examination duration and	120 min			
scale	Constal Engineering Science (Cormon program 7 const	star). Cracialization Machanical	Fraincasing Foo	
Following Curricula	General Engineering Science (German program, 7 semes Compulsory	ster): Specialisation Mechanical	Engineering, Foc	us Energy Syste
Following curricula	General Engineering Science (German program, 7 semester	. Specialization Biomedical Engin	eering: Compuls	
	General Engineering Science (German program, 7 semester			
	Engineering: Compulsory	7. Specialisation Mechanical Engli	leening, rocus m	
	Energy Systems: Technical Complementary Course Core Stu	idios: Electivo Compulsony		
	General Engineering Science (English program, 7 semes		Engineering Foc	us Energy System
	Compulsory	icer, specialisation mechallical i	Lighteening, POC	as Energy Syster
	General Engineering Science (English program, 7 semester)	- Specialisation Biomedical Engine	erina: Compulso	ry.
	Mechanical Engineering: Specialisation Energy Systems: Col		compuiso	· <i>y</i>
	Mechanical Engineering: Specialisation Energy Systems: Col Mechanical Engineering: Specialisation Theoretical Mechanic		00/	

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	r de la companya de l
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			Тур	I	Hrs/wk	СР
Embodiment Design and 3D-CAD (L			Lecture		2	1
Mechanical Design Project I (L0695			Project-/problem-based		3	2
Mechanical Design Project II (L0592			Project-/problem-based		3	2
Feam Project Design Methodology			Project-/problem-based	Learning	2	1
Module Responsible						
Admission Requirements	None					
Recommended Previous	 Fundamentals 	of Mechanical Engineering	Design			
Knowledge	 Mechanics 	5 5	5			
	 Fundamentals 	of Materials Science				
	 Production En 	gineering				
Educational Objectives	After taking part suc	cessfully, students have re-	ached the following learning results			
Professional Competence						
Knowledge	After passing the mo	dule, students are able to:				
	 explain design 	quidelines for machinery	oarts e.g. considering load situation, ma	terials and	manufacturi	na requirements
	 describe basic 		sures e.g. considering load stadtion, ma		manaraccan	ng requirements
		methods of engineering de	esianina.			
		and a second s	5 5			
Skills	After passing the mo	dule, students are able to:				
	 independently 	create sketches technical	drawings and documentations e.g. usin			
		nents based on design guid		g JD CAD,		
		lculate) used components,	lennes autonomously,			
			ering design tasks systamtically and solu	ition orient	od	
		ty techniques in teams.	and sold	ICIOII-OITEITIC	eu,	
		ty techniques in teams.				
Personal Competence						
Social Competence	After passing the module, students are able to:					
	 develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. 					
Autonomy	Students are able					
		a da la cal a 6 las accidadas contr		- (-12-1	
	• to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers),					
	To solve engineering design tasks systematically.					
Workload in Hours	Independent Study T	ime 40, Study Time in Lect	ure 140			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Written elaboration	3D-CAD-Praktikum			
	Yes None	Written elaboration	Teamprojekt Konstruktionsmethodik			
	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): Specialisation Mechanical	Engineerin	g: Compulso	bry
Following Curricula	General Engineering	Science (German program	, 7 semester): Specialisation Biomedical	Engineerin	g: Compulso	ory
	General Engineering	Science (German program	7 semester): Specialisation Biomedical	Engineerin	g: Compulso	ory
	General Engineering	Science (German program	7 semester): Specialisation Energy and	Enviromen	tal Enginee	ring: Compulsory
	Digital Mechanical Er	ngineering: Core qualificati	on: Compulsory		-	
	-	nental Engineering: Core qu				
		: Core qualification: Compu				
			7 semester): Specialisation Biomedical I	Engineering	: Compulso	ry
			pecialisation Energy Technology: Elective			-
	-	ing: Core qualification: Con			-	
	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. 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	rof. 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	ndependent 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

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Courses					
Title			Тур	Hrs/wk	СР
Practical Course: Measurement and	-		Practical Course	2	2
Measurement Technology for Mech			Lecture	2	3
Measurement Technology for Mech		[18]	Recitation Section (large)	1	1
Module Responsible					
Admission Requirements					
	Basic knowledge of p	physics, chemistry and electric	al engineering		
Knowledge					
	After taking part suc	cessfully, students have reach	ed the following learning results		
Professional Competence					
Knowledge			ndmentals of the Measurement Technol	ogy (Quantities an	d Units, Uncertair
	Calibration, Static a	nd Dynamic Properties of Sens	ors and Systems).		
	They can outline the	e most important measuring r	nethods for different kinds of quantities	to be maesured (Electrical Quantit
	-	anical quantities, Flow, Time, I			
	· · · · · · · · · · · · · · · · · · ·	,,,			
	They can describe in	nportant methods of chemical	Analysis (Gas Sensors, Spectroscopy, Ga	s Chromatography)
Skills	Students can select	suitable measuring methods to	given problems and can use refering m	easurement device	s in practice.
	The students are ab	lo to orally ovalain issues in th	a subject area of measurement technol	any and colution a	pproachos as wol
	The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well - place the issues into the right context and application area.				
	place the issues into	The right context and applicat			
Personal Competence					
Social Competence	Students can arrive	at work results in groups and o	locument them in a common report.		
Autonomy	Students are able to	familiarize themselves with ne	ew measurement technologies.		
Workload in Hours	Independent Study T	Time 110, Study Time in Lectur	re 70		
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	Yes None	Subject theoretical and	1		
		practical work			
	Subject theoretical a	and practical work			
Examination duration and	105 minutes				
scale					
			semester): Specialisation Mechanical Eng		
Following Curricula			semester): Specialisation Biomedical Eng		-
			semester): Specialisation Energy and Env	viromental Enginee	ring: Compulsory
	-	ngineering: Core qualification:			
		mental Engineering: Core quali			
		: Specialisation Mechatronics:			
	5 5	: Specialisation Mechanical En	5 7 7		
		: Specialisation Biomedical Eng			
			emester): Specialisation Energy and Env	-	
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory				
			emester): Specialisation Biomedical Engi		ry
			emester): Specialisation Mechatronics: C		
			emester): Specialisation Mechanical Eng		
			emester): Specialisation Biomedical Engi		ompulsory
			anagement and Processes: Elective Comp	oulsory	
	-	ring: Core qualification: Compu	Isory		
		and the section of a second second			
		qualification: Compulsory			
			s and Mobility: Specialisation Production	n Management and	d Processes: Elect

rse L1119: Practical Cour	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 gaseous pollutants in automotive exhaust are used.
	Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine wil be investigated. The starting will be simulated on a PC and compared with measurement.
	Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications with Michelson interferometer and optical fibers demonstrated.
	Experiment 4:Identification of the parameters of a control system and optimal control parameters
Literature	Versuch 1:
	 Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und am Arbeitsplatz. 2. Aufl. Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 2455 Bl.1 Versuch 2: Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen

Course L1116: Measurement	Technology for Mechanical Engineering		
Тур	Lecture		
Hrs/wk	2		
СР	3		
	Independent Study Time 62, Study Time in Lecture 28		
	Prof. Thorsten Kern, Dennis Kähler		
Language			
Cycle	WiSe 1 Fundamentals		
content	1.1 Quantities and Units		
	1.2 Uncertainty		
	1.3 Calibration		
	1.4 Static and Dynamic Properties of Sensors and Systems		
	2 Measurement of Electrical Quantities		
	.1 Current and Voltage		
	2.2 Impedance		
	2.3 Amplification		
	2.4 Oscilloscope		
	2.5 Analog-to-Digital Conversion		
	.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
Numerical Mathematics I (L0417)		Lecture	2	3
Numerical Mathematics I (L0418)		Recitation Section (small)	2	3
Module Responsible	Prof. Sabine Le Borne			
Admission Requirements Recommended Previous	None			
Knowledge	Mathematik I + II for Engineering Students (german or eng	lish) or Analysis & Linear Alg	ebra I + II for Teo	chnomathematici
J.	 basic MATLAB/Python knowledge 			
Educational Objectives	After taking part successfully, students have reached the followin	g learning results		
Professional Competence				
Knowledge	Students are able to			
	 name numerical methods for interpolation, integration, lea 	st squares problems, eigenva	alue problems, n	onlinear root find
	problems and to explain their core ideas,			
	repeat convergence statements for the numerical methods			
	 explain aspects for the practical execution of numerical me 	thods with respect to compu	tational and stor	age complexitx.
Skills	Students are able to			
Skins				
	 implement, apply and compare numerical methods using N institution the comparence holocular of numerical methods using N 		d colution algorit	la na
	 justify the convergence behaviour of numerical methods w select and execute a suitable solution approach for a given 		d solution algorit	nm,
	- Select and execute a saturable solution approach for a given	problem.		
Personal Competence	Chudauha ang abla ba			
Social Competence	Students are able to			
	work together in heterogeneously composed teams (i.e., teams)			
	explain theoretical foundations and support each other with	h practical aspects regarding	the implementat	tion of algorithms
Autonomy	Students are capable			
	 to assess whether the supporting theoretical and practical 	excercises are better solved i	individually or in	a team
	 to assess their individual progess and, if necessary, to ask 			a team,
	Independent Study Time 124, Study Time in Lecture 56			
Credit points Course achievement	6 None			
Examination				
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 semester): Spe	cialisation Computer Science	: Compulsory	
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanica	al Engineering,	Focus Materials
	Engineering Sciences: Compulsory	cialization Riomodical Engine	oring: Compulso	24
	General Engineering Science (German program, 7 semester): Spe General Engineering Science (German program, 7 semester)			
	Compulsory		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	General Engineering Science (German program, 7 semester): Spe	ecialisation Mechanical Engine	eering, Focus Th	eoretical Mechan
	Engineering: Compulsory			
	Engineering: Compulsory General Engineering Science (German program, 7 semester):			
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory	Specialisation Mechanical E	ngineering, Foc	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester):	Specialisation Mechanical E	ngineering, Foc	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe	Specialisation Mechanical E	ingineering, Foci	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory	Specialisation Mechanical E	ingineering, Foci	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engi	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor	ngineering, Focu eering, Focus Me ngineering, Focu	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Elective	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory	ngineering, Focu eering, Focus Me ngineering, Focu Y	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory	ngineering, Focu eering, Focus Me ngineering, Focu Y	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Elective	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory	ngineering, Focu eering, Focus Me ngineering, Focu Y	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering Data Science: Core qualification: Compulsory	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory	ngineering, Focu eering, Focus Me ngineering, Focu Y	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engi Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Elective Compulsory Engineering Science: Core qualification: Compulsory Engineering Science: Core qualification: Compulsory Engineering Science: Core qualification: Compulsory	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor	ngineering, Focu eering, Focus Me ngineering, Focu Y	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Elective Compulsory Engineering Science: Core qualification: Compulsory Engineering Science: Core qualification: Compulsory Engineering Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory	eering, Focus Me ngineering, Focu Y TY	us Aircraft Syste
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Elective Compulsory Engineering Science: Core qualification: Compulsory Engineering Science: Core qualification: Compulsory Engineering Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core General Engineering Science (English program, 7 semester): Spece	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory ialisation Computer Science:	eering, Focus Me ngineering, Focu y ry Compulsory	us Aircraft Syste echatronics: Elect us Energy System
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering 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	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory ialisation Computer Science:	eering, Focus Me ngineering, Focu y ry Compulsory	us Aircraft Syste echatronics: Elect us Energy System
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering 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 General Engineering Science (English program, 7 semester): Spec	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory isalisation Computer Science: Specialisation Mechanical	eering, Focus Me ngineering, Focu y ry Compulsory Engineering, Fo	us Aircraft Syste echatronics: Elect us Energy System bocus Biomechan
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering 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 General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory isalisation Computer Science: Specialisation Mechanical	eering, Focus Me ngineering, Focu y ry Compulsory Engineering, Fo	us Aircraft Syste echatronics: Elect us Energy System bocus Biomechan
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering 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): Spec General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec Sciences: Compulsory General Engineering Science (English program, 7 semester): Spec Sciences: Compulsory	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory cialisation Computer Science: Specialisation Mechanical cialisation Mechanical Engine	eering, Focus Me ngineering, Focu y ry Compulsory Engineering, Focus Mat	us Aircraft Syste echatronics: Elect us Energy System ocus Biomechan erials in Engineer
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering 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): Spec General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec Sciences: Compulsory General Engineering Science (English program, 7 semester): Spec Sciences: Compulsory	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor qualification: Compulsory cialisation Computer Science: Specialisation Mechanical Engineering cialisation Mechanical Engineering	eering, Focus Me ngineering, Focu y ry Compulsory Engineering, Fo ering, Focus Mat	us Aircraft Syste echatronics: Elect us Energy Syster ocus Biomechan erials in Engineer eoretical Mechan
	Engineering: Compulsory General Engineering Science (German program, 7 semester): Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Spe Compulsory General Engineering Science (German program, 7 semester): Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Eng Computer Science: Specialisation Computational Mathematics: Ele Computer Science: Specialisation II. Mathematics and Engineering 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): Spec General Engineering Science (English program, 7 semester): Spec General Engineering Science (English program, 7 semester): Spec Sciences: Compulsory General Engineering Science (English program, 7 semester): Spec Sciences: Compulsory	Specialisation Mechanical E ecialisation Mechanical Engin Specialisation Mechanical E gineering: Elective Compulsor ective Compulsory g Science: Elective Compulsor ialisation Computer Science: Specialisation Mechanical cialisation Mechanical Engine cialisation Mechanical Engine	ingineering, Focu eering, Focus Me ngineering, Focu y ry Compulsory Engineering, Fo ering, Focus Mat eering, Focus The ering: Compulsor	us Aircraft Syste echatronics: Elect us Energy Syster ocus Biomechan erials in Engineer eoretical Mechan

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	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
Introduction into Medical Technology and Systems (L0342)			Lecture	2	3
ntroduction into Medical Technolog	gy and Systems (L0343	3)	Project Seminar	2	2
ntroduction into Medical Technolog	gy and Systems (L1876	6)	Recitation Section (large)	1	1
Module Responsible	Prof. Alexander Sch	laefer			
Admission Requirements	None				
Recommended Previous	principles of math (a	(algebra, analysis/calculus)			
Knowledge	principles of stocha	astics			
	principles of program	imming, R/Matlab			
Educational Objectives	After taking part su	ccessfully, students have reach	ed the following learning results		
Professional Competence	511	,,			
•	The students can	explain principles of medical t	echnology, including imaging systems, (computer aided s	urgery, and med
			view of regulatory affairs and standards in		
Skills	The students are ab	ble to evaluate systems and me	dical devices in the context of clinical app	lications.	
Personal Competence					
Social Competence	The students descri	ibe a problem in medical techno	logy as a project, and define tasks that a	re solved in a joint	effort.
Autonomy	The students can reflect their knowledge and document the results of their work. They can present the results in an appropria				
	manner.				
Workload in Hours	kload in Hours Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	Compulsory Bonus	Form	Description		
	Yes 10 %	Presentation			
	Yes 10 %	Written elaboration			
	Written exam				
Examination duration and	90 minutes				
scale	0 15 1	<u> </u>			
-	-		semester): Specialisation Biomedical Engi	neering: Compuls	ory
Following Curricula			oftware Engineering: Elective Compulsory nd Engineering Science: Elective Compuls	ony	
		qualification: Elective Compulse		Jory	
		ng: Core qualification: Elective (
	-	e: Specialisation Biomedical Eng			
			emester): Specialisation Biomedical Engin	eering: Compulso	ry
			tion II. Mathematics & Engineering Science		
	Biomedical Enginee	ering: Specialisation Artificial Org	gans and Regenerative Medicine: Elective	Compulsory	
	Biomedical Enginee	ering: Specialisation Implants an	d Endoprostheses: Elective Compulsory		
	Biomedical Enginee	ering: Specialisation Medical Tec	hnology and Control Theory: Elective Con	npulsory	
	-	ering: Specialisation Managemer	nt and Business Administration: Elective C	ompulsory	

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

Course L0343: Introduction into Medical Technology and Systems		
Тур	roject Seminar	
Hrs/wk		
СР		
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28	
Lecturer	rof. Alexander Schlaefer	
Language	DE	
Cycle	e SoSe	
Content	See interlocking course	
Literature	ture See interlocking course	

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

Courses					
Title		Тур	Hrs/wk	СР	
Experimental Methods in Biomecha	nics (L0377)	Lecture	2	3	
Module Responsible	Prof. Michael Morlock				
Admission Requirements	None				
Recommended Previous	It is recommended to participate in "Implantate und Frakturheilung" before attending "Experimentelle Methoden".				
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	ways how bones heal, and the requirements f	for their existence.		
	The students can name different treatme	ents for the spine and hollow bones under giv	ven fracture morphologies		
	The students can describe different mea	surement techniques for forces and moveme	ents, and choose the adec	iuate technique fo	
	The students can describe different measurement techniques for forces and movements, and choose the adequate technique f given task.				
	given work.				
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 Mechanical Engineering, Focus Biome			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 Biomechanic				
	Compulsory				
		ogram, 7 semester): Specialisation Biomedica		-	
		ogram, 7 semester): Specialisation Biomedica	al Engineering: Elective C	ompulsory	
	Mechanical Engineering: Specialisation B Technomathematics: Specialisation III. En				

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

Courses				
Title		Typ	Hrs/wk	СР
Management Tutorial (L0882)		Typ Recitation Section (small)	2	3
ntroduction to Management (L088	0)	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous				
Knowledge				
	After taking part successfully, students have rea	ched the following learning results		
Professional Competence	······			
-	After taking this module, students know the imp and Organisation to Marketing and Innovation, a			
	 explain the differences between Economics and Management and the sub-disciplines in Management and to nan important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneuri projects describe and explain basic business functions as production, procurement and sourcing, supply chain management organization and human ressource management, information management, innovation management and marketing 			
 organization and human ressource management, information management explain the relevance of planning and decision making in Business, uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling method 			tions under mul	tiple objectives
Skills	Students are able to analyse business units with out an Entrepreneurship project in a team. In pa	rticular, they are able to	jectives, strategi	es etc.) and to c
	analyse Management goals and structure			
	analyse organisational and staff structure		dor siels	
	 apply methods for decision making under analyse production and procurement syst 	multiple objectives, under uncertainty and un	ider risk	
	 analyse production and procurement systematics analyse and apply basic methods of mark 			
	 select and apply basic methods from mat 			
	 apply basic methods from accounting, cos 			
Personal Competence				
-	Students are able to			
Social Competence				
	 work successfully in a team of students to apply their knowledge from the lecture to communicate appropriately and 	to an entrepreneurship project and write a co	herent report on	the project
	 to cooperate respectfully with their fellow 	students.		
Autonomy	Students are able to			
	 work in a team and to organize the team 	themselves		
	 to write a report on their project. 			
	Independent Study Time 110, Study Time in Lec	ture 70		
Workload in Hours				
Workload in Hours Credit points	6			
Credit points Course achievement				
Credit points Course achievement Examination	None			
Credit points Course achievement Examination	None Subject theoretical and practical work			
Credit points Course achievement Examination Examination duration and scale	None Subject theoretical and practical work	7 semester): Core qualification: Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester			
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program,	tion Civil Engineering: Elective Compulsory	Sory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul	sory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul tion Traffic and Mobility: Elective Compulsory	sory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul tion Traffic and Mobility: Elective Compulsory pulsory	sory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulsory	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul tion Traffic and Mobility: Elective Compulsory pulsory ry	sory	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compu Energy and Environmental Engineering: Core qualification: Compu	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul tion Traffic and Mobility: Elective Compulsory pulsory ry ilsory alification: Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compu Energy and Environmental Engineering: Core qu General Engineering Science (English program, 5	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul tion Traffic and Mobility: Elective Compulsory pulsory ry ilsory alification: Compulsory 7 semester): Specialisation Electrical Engineer	ing: Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulso Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Comput Energy and Environmental Engineering: Core qualification: Comput General Engineering Science (English program, T General Engineering Science (English program, T	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul tion Traffic and Mobility: Elective Compulsory pulsory ry allory alification: Compulsory 7 semester): Specialisation Electrical Engineer 7 semester): Specialisation Civil Engineering: 0	ing: Compulsory Compulsory	
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Credit points Course achievement Examination Examination duration and scale Assignment for the	None Subject theoretical and practical work several written exams during the semester General Engineering Science (German program, Civil- and Environmental Engineering: Specialisa Civil- and Environmental Engineering: Specialisa Bioprocess Engineering: Core qualification: Comp Computer Science: Core qualification: Compulso Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qu General Engineering Science (English program, General Engineering Science (English program,	tion Civil Engineering: Elective Compulsory tion Water and Environment: Elective Compul- tion Traffic and Mobility: Elective Compulsory pulsory ry alification: Compulsory 7 semester): Specialisation Electrical Engineer 7 semester): Specialisation Civil Engineering: 0 7 semester): Specialisation Bioprocess Engine 7 semester): Specialisation Energy and Enviro 7 semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical	ing: Compulsory Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, F	ng: Compulsory ocus Biomechar
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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 busine knowledge from the lecture should come to practical use. The group projects are guided by a mentor.			
Litoratura	Relevante Literatur aus der korrespondierenden Vorlesung.			

Literature Relevante Literatur aus der korrespondierenden Vorlesung.

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

Courses					
Title		Тур	Hrs/wk	СР	
Introduction 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 	metabolism			
		n selected fields of muscle, heart/circulation, r	neuro- and sensory physic	alogy	
			icaro ana sensory prijole		
Skills		f basic bodily functions (sensory, transmissior	n and processing of inform	mation, developm	
	of forces and vital functions) and relate	them to similar technical systems.			
Personal Competence					
Social Competence	The students can conduct discussions in research and medicine on a technical level.				
	The students can find solutions to proble	ems in the field of physiology, both analytical	and metrological.		
Autonomy	y The students can derive answers to questions arising in the course and other physiological areas, using technical literature,				
	themselves.				
Workload in Hours	Independent Study Time 62, Study Time	e in Lecture 28			
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	60 minutes				
scale					
Assignment for the		rogram, 7 semester): Specialisation Biomedic		-	
Following Curricula		n program, 7 semester): Specialisation Me	echanical Engineering, F	ocus Biomechan	
	Compulsory				
	Data Science: Specialisation Medicine: (
	Electrical Engineering: Specialisation Me				
		medical Engineering: Elective Compulsory	schapical Engineering E	acus Piomachan	
	Compulsory	program, 7 semester): Specialisation Me	chanical Engineering, r	ocus biomechan	
		ogram, 7 semester): Specialisation Biomedica	l Engineering: Compulso	n/	
		-		-	
	General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory				
		Medical Technology and Control Theory: Electi	ve Compulsorv		
		Management and Business Administration: Ele			
		Artificial Organs and Regenerative Medicine: E			
		mplants and Endoprostheses: Elective Compu			
	Technomathematics: Specialisation III. E				

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

Specialization Naval Architecture

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

Courses				
Title		Тур	Hrs/wk	СР
Fundamentals of Materials Science	I (L1085)	Lecture	2	2
Fundamentals of Materials Science	II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of M	aterials Science (L1095)	Lecture	2	2
Module Responsible	Prof. Jörg Weißmüller			
Admission Requirements	None			
Recommended Previous	Highschool-level physics, chemistry und mathematics			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence		5		
-	The students have acquired a fundamental knowledge on r	metals, ceramics and	polymers and can descr	ibe this knowled
-	comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagra			
	phase transformations, corrosion and mechanical properties. The	he students know abou	ut the key aspects of chara	acterization meth
	for materials and can identify relevant approaches for cha	aracterizing specific p	roperties. They are able	to trace mater
	phenomena back to the underlying physical and chemical laws	of nature.		
Skills	The students are able to trace materials phenomena back t			
	phenomena here refers to mechanical properties such as stre			
	resistance, and to phase transformations such as solidification	on, precipitation, or m	nelting. The students can	explain the related
	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				
Credit points				
Course achievement	Written exam			
Examination duration and				
scale		pocialization Mochanic	cal Engineering: Compulso	
scale	General Engineering Science (German program, 7 semester): S	рестапзастот месталіс	5 5 1	ry
scale Assignment for the	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S			
scale Assignment for the		pecialisation Biomedic	cal Engineering: Compulso	ry
scale Assignment for the	General Engineering Science (German program, 7 semester): S	pecialisation Biomedic	cal Engineering: Compulso nd Enviromental Engineer	ry
scale Assignment for the	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	pecialisation Biomedic pecialisation Energy a pecialisation Naval Arc	cal Engineering: Compulso nd Enviromental Engineer chitecture: Compulsory	ry
scale Assignment for the	General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S	pecialisation Biomedic pecialisation Energy a pecialisation Naval Arc	cal Engineering: Compulso nd Enviromental Engineer chitecture: Compulsory	ry
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scale Assignment for the	General Engineering Science (German program, 7 semester): S 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	pecialisation Biomedic pecialisation Energy a pecialisation Naval Arc pecialisation Naval Arc	cal Engineering: Compulso nd Enviromental Engineer chitecture: Compulsory	ry
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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	s of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider
Language	DE
Cycle	SoSe
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471- 32013-7

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

Courses	
Title	Typ Hrs/wk CP
Hydrostatics (L1260)	TypHrs/wkCPLecture23
Hydrostatics (L1261)	Recitation Section (large) 2 1
Body Plan (L1452)	Project Seminar 2 2
Module Responsible	
Admission Requirements Recommended Previous	None Good knowledge in Mathemathics I-III and Mechanics I-III.
Knowledge	
	It is recommended that the students are familiar with typical design relevant drawings, e.g. Body Plan, GA- Plan, Tank Plan
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The lecture enables the student to carry out all necessary theoretical calculations for ship design on a scientific level. The
	is basic requirement for all following lectures in the subjects shipo design and safety of ships.
Skills	The student is able to carry out hydrostatic calculations to ensure that the ship has sufficient stability. He is able to des
	forms that are safe against capsizing or sinking.
Personal Competence	
Social Competence	The student gets access to hydrostatical problems.
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	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory
J.	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
	Naval Architecture: Core qualification: Compulsory
Course L1260: Hydrostatics	
course E1200. Hydrostatics	
Тур	l ecture
Typ Hrs/wk	Lecture 2
	2
Hrs/wk CP	2
Hrs/wk CP Workload in Hours	2 3
Hrs/wk CP Workload in Hours	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger
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
Hrs/wk CP Workload in Hours Lecturer Language Cycle	2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE
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
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
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments
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 Integration Methods
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition
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 Integration Methods - 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
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 Integration Methods - 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
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 Integration Methods - 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
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 Integration Methods - 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
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - 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
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 Integration Methods - 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
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 Integration Methods - 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
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 Integration Methods - 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
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Floating Condition - Trim Tables 3. Stability at large heeling angles - Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves - Heeling Moments of Free Surfaces, Water on Deck, Water Ingress - Heeling Moments of Different Type
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Floating Condition - Trables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves - Heeling Moments of Free Surfaces, Water on Deck, Water Ingress
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 Integration Methods - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Floating Condition - Trim Tables 3. Stability at large heeling angles - Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers - Numerical and Graphical Determination of Cross Curves - Heeling Moments of Free Surfaces, Water on Deck, Water Ingress - Heeling Moments of Different Type

- Linearization of Restoring Forces and Moments
- Correlation between Metacentric Height and Righting Lever at small heeling angles
- Computation of Path of Metacentric Height for Modern Hull Forms
- Correlation between Righting Lever and Path of Metacentric Height
- Hydrostatic Stiffness Matrix
- Definition of MCT
- Computation of Equilibrum Floating Conditions from Hydrostatic Tables
- Effect of Free Surfaces on Initial GM
- Roll Motions at Small Roll Angles
6. Stability in Waves
- Roll Motions at Large Amplitudes
- Pure Loss of Stability on the Wave Crest
- Principle of Parametric Excitation
- Principle of Direct Wave Moments
- Grim´s Equivalent Wave Concept
6 Longitudinal Strength
- Longitudinal Mass Distribution, Shear Forces, Bending Moments
- Longitudinal Strength in Stability Booklet
7. Deadweight Survey and Inclining Experiment
- Deplacement Computations from Draft mark Readings
- Weights to go on /come from board
- Inclining Experiment with Heeling Moments from Weights and Heeling Tanks
- Residual Sounding Volumes
- Determination of COG from Metacentric height and from Cross Curves
- Roll Decay Test
8. Launching and Docking
- Launching Plan, Arrangement of Launching Blocks
- Rigid Body Launching: Tilting, Dumping, Equation of Techel
- Computation of Launching Event
- Bottom Pressure and Longitudinal Strength
- Linear- Elastic Effects
- Transversal Stability on Slipway and in Dock
9. Grounding
- Loss of Buoynacy when Grounded
- Pointwise Grounding
- Ship Grounds on Keel
10. Introduction into Damage Stability Problems
- Added Mass Method
- Loss of Buoyant Volume Method
- Simple Equilibrium Computations
- Intermediate Stages of Flooding (Addes Mass Method), Cross- and Downflooding
- Water Ingress Through Openings
11. Special Problems (optional and agreed upon)
- e.g. Heavy Lift Operations
- e.g. Jacking of Jackup Vessels
- e.g. Sinking After Water Ingress

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

Course L1261: Hydrostatics	
Тур	Recitation Section (large)
Hrs/wk	2
CP	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				
Fitle		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			
	Basic knowledge in electrical engineering			
Knowledge				
	After taking part successfully, students have reached the	e following learning results		
Professional Competence Knowledge	This module deals with the foundations of the function programming down to gates. The module includes the fo • Introduction		s the layers fron	n the assembly-le
	 Combinational logic: Gates, Boolean algebra, Boo Sequential logic: Flip-flops, automata, systematic Technological foundations Computer arithmetic: Integer addition, subtraction Basics of computer architecture: Programming me Memories: Memory hierarchies, SRAM, DRAM, cac Input/output: I/O from the perspective of the CPU, 	hardware design n, multiplication and division odels, MIPS single-cycle architecture, hes	pipelining	
Skills	The students perceive computer systems from the archi composition of computer systems. The students can and collection of few and simple components. They are able today's computing systems - from gates and circuits up 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 ass the impact that these low abstraction levels have on an	alyze, how highly specific and individu e to distinguish between and to expli- to complete processors. Its are able to judge the interdepend ney shall understand the consequence embly language down to gates. This	al computers can ain the different encies between es that the exect way, they will be	n be built based of abstraction layer a physical compu- ution of software enabled to evalu
Personal Competence				
	Students are able to solve similar problems alone or in a	group and to present the results acc	ordinaly.	
social competence		group and to present the results dee	ordingry.	
Autonomy	Students are able to acquire new knowledge from specif	ic literature and to associate this know	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement		iption		
	Yes 10 % Excercises			
Examination duration and scale	90 minutes, contents of course and labs			
	General Engineering Science (German program, 7 seme	ster): Specialisation Computer Science	e. Compulsory	
Following Curricula	General Engineering Science (German program, 7 seme: General Engineering Science (German program, 7 seme:	ster): Specialisation Naval Architectur ster): Specialisation Electrical Enginee ster): Specialisation Biomedical Engin ster): Specialisation Energy and Enviro	e: Compulsory ering: Compulsory eering: Compulso omental Engineer	/ pry
	General Engineering Science (German program, 7 s Compulsory General Engineering Science (German program, 7 s	•		ocus Mechatron
			Englicening, i	ocus Biomechar
	Compulsory General Engineering Science (German program, 7 se Engineering: Compulsory	mester): Specialisation Mechanical		
	General Engineering Science (German program, 7 se	semester): Specialisation Mechanic	Engineering, Foc al Engineering,	us Aircraft Syste Focus Materials
	General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory	semester): Specialisation Mechanic ster): Specialisation Mechanical Engir	Engineering, Foc al Engineering, neering, Focus Th	us Aircraft Syste Focus Materials eoretical Mechan
	General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 seme Engineering: Compulsory General Engineering Science (German program, 7 seme and Production: Compulsory General Engineering Science (German program, 7 se Compulsory	semester): Specialisation Mechanic ster): Specialisation Mechanical Engir ester): Specialisation Mechanical Engi mester): Specialisation Mechanical I	Engineering, Foc al Engineering, neering, Focus Th ineering, Focus P Engineering, Foc	us Aircraft Syste Focus Materials ecoretical Mechar roduct Developm us Energy Syste
	General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 seme Engineering: Compulsory General Engineering Science (German program, 7 seme and Production: Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 seme	semester): Specialisation Mechanica ster): Specialisation Mechanical Engir ester): Specialisation Mechanical Engi mester): Specialisation Mechanical I mester): Specialisation Mechanical I	Engineering, Foc al Engineering, neering, Focus Th Ineering, Focus P Engineering, Foc Engineering, Foc	us Aircraft Syste Focus Materials ecoretical Mechar roduct Developm us Energy Syste
	General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 seme Engineering: Compulsory General Engineering Science (German program, 7 seme and Production: Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 seme Computer Science: Core qualification: Compulsory	semester): Specialisation Mechanica ster): Specialisation Mechanical Engir ester): Specialisation Mechanical Engi mester): Specialisation Mechanical I mester): Specialisation Mechanical I	Engineering, Foc al Engineering, neering, Focus Th Ineering, Focus P Engineering, Foc Engineering, Foc	us Aircraft Syste Focus Materials ecoretical Mechar roduct Developm us Energy Syste
	General Engineering Science (German program, 7 se Engineering: Compulsory General Engineering Science (German program, 7 Engineering Sciences: Compulsory General Engineering Science (German program, 7 seme Engineering: Compulsory General Engineering Science (German program, 7 seme and Production: Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 seme	semester): Specialisation Mechanica ster): Specialisation Mechanical Engir ester): Specialisation Mechanical Engi mester): Specialisation Mechanical I mester): Specialisation Mechanical I ster): Specialisation Civil Engineering: ter): Specialisation Electrical Engineer	Engineering, Foc al Engineering, meering, Focus Th ineering, Focus P Engineering, Foc Engineering, Foc Compulsory ring: Compulsory	us Aircraft Syst Focus Materials recoretical Mechar roduct Developn us Energy Syste us Energy Syste

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

Course L0321: Computer Engineering	
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Heiko Falk
Language	DE/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

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Courses				
Title		Тур	Hrs/wk	СР
	al Mechanics, Numerical Mechanics) (L1137)	Lecture	3 2	3 2
-	al Mechanics, Numerical Mechanics) (L1138) al Mechanics, Numerical Mechanics) (L1139)	Recitation Section (small) Recitation Section (large)	1	2
Module Responsible			_	
Admission Requirements				
	Mathematics I-III and Mechanics I-III			
Knowledge				
	After taking part successfully, students have reached	the following learning results		
Professional Competence	After taking part successionly, students have reached	the following learning results		
-	The students can			
Knowledge				
	 describe the axiomatic procedure used in mech 	nanical contexts;		
	 explain important steps in model design; 			
	 present technical knowledge. 			
Skills	The students can			
	 explain the important elements of mathematic 	al / 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 method 	ods and extend them to be applicable to	o wider problem	sets.
Personal Competence				
Social Competence	The students can work in groups and support each ot	her to overcome difficulties.		
Autonomy	Students are capable of determining their own streng	ths and weaknesses and to organize the	ir time and learn	ing based on those
	Independent Study Time 96, Study Time in Lecture 84	•		
Credit points Course achievement				
Examination				
Examination duration and scale	120 min			
	Constal Engineering Science (Corman program, 7 cor	nostor), Specialization Machanical Engin	ooring, Compuls	254
Following Curricula	General Engineering Science (German program, 7 ser General Engineering Science (German program, 7 ser			
Following curricula				лу
	General Engineering Science (German program, 7 ser		e: compulsory	
	Energy Systems: Technical Complementary Course Co			
	General Engineering Science (English program, 7 sem			ry
	General Engineering Science (English program, 7 sem			
	General Engineering Science (English program, 7 sem		ering: Compuiso	ry
	Mechanical Engineering: Core qualification: Compulso	ry		
	Mechatronics: Core qualification: Compulsory			
	Naval Architecture: Core qualification: Compulsory			
	Technomathematics: Specialisation III. Engineering So		Companyle	
	Theoretical Mechanical Engineering: Technical Compl	ementary Course Core Studies: Elective	compuisory	
Course 1127, Markaula IV	(Oscillations Analytical Markey's New 1	- chowice)		
	(Oscillations, Analytical Mechanics, Numerical M	ecnanics)		
	Lecture			
Hrs/wk				
CP	3			
	Independent Study Time 48, Study Time in Lecture 42			

CF	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
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).

Content

See interlocking course

Literature See interlocking course

Course L1138: Mechanics IV (Oscillat	
	tions, Analytical Mechanics, Numerical Mechanics)
Typ Recitation	ion Section (small)
Hrs/wk 2	
CP 2	
Workload in Hours Indepen-	ndent Study Time 32, Study Time in Lecture 28
Lecturer Prof. Rol	bert Seifried
Language DE	
Cycle SoSe	
Content See inte	erlocking course
Literature See inte	erlocking course
Course L1139: Mechanics IV (Oscillat	tions, Analytical Mechanics, Numerical Mechanics)
Typ Recitation	ion Section (large)
Hrs/wk 1	
CP 1	
Workload in Hours Independent	ndent Study Time 16, Study Time in Lecture 14
Lecturer Prof. Rol	bert Seifried
Language DE	
Cycle SoSe	

Module M0854: Mathe	ematics IV			
Courses				
Title		Тур	Hrs/wk	СР
Differential Equations 2 (Partial Diff	ferential Equations) (L1043)	Lecture	2	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1044)	Recitation Section (small)	1	1
Differential Equations 2 (Partial Diff	ferential Equations) (L1045)	Recitation Section (large)	1	1
Complex Functions (L1038)		Lecture	2	1
Complex Functions (L1041)		Recitation Section (small)	1	1
Complex Functions (L1042)		Recitation Section (large)	1	1
Module Responsible	Prof. Anusch Taraz			
Admission Requirements	None			
Recommended Previous	Mathematics 1 - III			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge	Students can name the basis concents in Mathemat	ice IV. They are able to evoluin ther	n using appropri	ata ayamplas
	 Students can name the basic concepts in Mathemat Students can discuss logical connections between the 			
	 Students can discuss logical connections between t the below of examples 	hese concepts. They are capable	of illustrating in	ese connections with
	the help of examples.			
	 They know proof strategies and can reproduce them 	1.		
Skills	 Students can model problems in Mathematics IV w 	ith the help of the concepts studie	d in this course	Moreover they are
	capable of solving them by applying established me			. Moreover, they are
	 Students are able to discover and verify further logic 		ots studied in the	course
	 For a given problem, the students can develop ar 			
	results.	a execute a suitable approach, a		including evaluate the
	results.			
Personal Competence				
Social Competence	 Students are able to work together in teams. They a 	re canable to use mathematics as a	a common langu	ane.
	 In doing so, they can communicate new concepts a 			
	design examples to check and deepen the understa		clusing parates	. Moreover, and, ca
	design examples to check and deepen are different	nully of their peers.		
Autonomy				
Autonomy	 Students are capable of checking their understandi 	ng of complex concepts on their o	wn. They can sp	ecify open questions
	precisely and know where to get help in solving the	n.		
	• Students have developed sufficient persistence to	be able to work for longer period	s in a goal-orien	ted manner on hard
	problems.		-	
Workload in Hours	Independent Study Time 68, Study Time in Lecture 112			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	60 min (Complex Functions) + 60 min (Differential Equatio	ns 2)		
scale				
Assignment for the	General Engineering Science (German program, 7 semeste	r): Specialisation Electrical Enginee	ring: Compulsor	у
Following Curricula	General Engineering Science (German program, 7 ser	nester): Specialisation Mechanica	l Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (German program, 7 semeste	r): Specialisation Naval Architecture	e: Compulsory	
	General Engineering Science (German program, 7 semeste	er): Specialisation Mechanical Engin	eering, Focus Th	neoretical Mechanical
	Engineering: Elective Compulsory			
	Computer Science: Specialisation Computational Mathema	tics: Elective Compulsory		
	Computer Science: Specialisation II. Mathematics and Engi	neering Science: Elective Compulso	ry	
	Electrical Engineering: Core qualification: Compulsory			
	Engineering Science: Specialisation Electrical Engineering:	Compulsory		
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineer	ing: Compulsory	,
	General Engineering Science (English program, 7 semester	r): Specialisation Electrical Engineer	ing: Compulsory	,
	General Engineering Science (English program, 7 sen	nester): Specialisation Mechanica	Engineering,	Focus Mechatronics:
	Compulsory			
	General Engineering Science (English program, 7 semeste	r): Specialisation Mechanical Engin	eering, Focus Th	neoretical Mechanical
	Engineering: Compulsory			
	General Engineering Science (English program, 7 semester): Specialisation Naval Architecture	: Compulsory	
	Computational Science and Engineering: Specialisation II. I			ulsory
	Mechanical Engineering: Specialisation Mechatronics: Com			,
	Mechanical Engineering: Specialisation Theoretical Mechan		ory	
	Mechanical Engineering: Specialisation Theoretical Mechan		,	
	Mechatronics: Core qualification: Compulsory	5 - 5 - 1 - 1 - 1 - 1		
	Naval Architecture: Core qualification: Compulsory			

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

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

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

Course L1038: Complex Functions		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	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

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, engine	eering mechanics and thermodynamics.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students will have the required sound knowledge t	o explain the general principles of flui	id engineering a	nd physics of fluid
	Students can scientifically outline the rationale of flo	w physics using mathematical models a	and are familiar v	vith methods for t
	performance analysis and the prediciton of fluid engir	eering devices.		
Skills	Students are able to apply fluid-engineering principle			
	enables the student to carry out all necessary theor	etical calculations for the fluid dynamic	c design of engir	leering devices or
	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	or complex problems self-consistent and	l crtically analyse	results
	····			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German program, 7 ser	pester): Specialisation Mechanical Engin	eering: Compulse	orv
Following Curricula	General Engineering Science (German program, 7 ser			-
	General Engineering Science (German program, 7 ser			.,
	General Engineering Science (English program, 7 sem			~v
	General Engineering Science (English program, 7 sem		÷ .	5
	General Engineering Science (English program, 7 sem	•		v
	Computational Science and Engineering: Specialisatio			3
	Mechanical Engineering: Core qualification: Compulso			
	Naval Architecture: Core qualification: Compulsory	· J		
	Technomathematics: Specialisation III. Engineering Sc	ionso, Elective Compulsory		

Course L0454: Fluid Mechan	ics
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thomas Rung
Language	DE/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.

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 Fundamentals of Chin Structural D	cian (10411)	Typ Lecture	Hrs/wk 2	CP 2
Fundamentals of Ship Structural Design (L0411) Fundamentals of Ship Structural Design (L0413)		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				
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 rea	ached the following learning results		
Professional Competence				
Knowledge	Students can reproduce the basic contents of the	ne structural behaviour of ship structures; th	ey can explain the	e theory and metho
	for the calculation of deformations and stresses	in beam-like structures.		
	Furthermore, they can reproduce the basis car	tente of order (rules) meteriale considirie	and preducts inim	ing and principles
	Furthermore, they can reproduce the basis con		nea products, join	ing and principles
	structural design of components in the ship stru	icture.		
CI-:!!-	Chudanta and an all of an him the method		6	
SKIIIS	Students are capable of applying the method		formations and s	tresses in the abo
	mentioned structures; they can choose calculat	ion models of typical ship structures.		
	Furthermore, they are capable to apply the me	thods of drawing and sizing the ship structu	ire; they can sele	ct suitable materia
	semi-finished products and joints.			
Personal Competence				
Social Competence	The students are able to communicate and co	operate in a professional environment in th	ne shipbuilding ar	nd component supp
	industry.			
Autonomy	The students are capable to independently ide	alize real ship structures and to select suit	able methods for	analysis of beam-li
hatehenny	structures; they are capable to assess the resul			
	Furthermore, they are capable to assess dr	awings of complex ship structures and t	o design ship st	ructures for vario
	requirements and boundary conditions.			
	Independent Study Time 156, Study Time in Lee	ture 84		
Credit points	8			
Course achievement	None			
Examination	Written exam			
Examination duration and	3 hours			
scale				
Assignment for the	General Engineering Science (German program	, 7 semester): Specialisation Naval Architectu	ire: Compulsory	
Following Curricula	General Engineering Science (English program,			
-	Naval Architecture: Core gualification: Compulse	•		

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

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

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
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	s None			
Recommended Previous	s 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 ha	ave reached the following learning results		
Professional Competence	2			
Knowledge	e Students can reproduce design and sizing	g as well as fabrication of the different areas of s	hip structures and c	of different ship typ
	(incl. detail design); they can describe cal	lculation models for complex structures.		
Skills	Students are capable to specify the requirements for different ship types and areas of the hull, to define design criteria for components, to select suitable calculation models and to assess the chosen structure			
Personal Competence	3			
Social Competence	Students are capable to present their structure	uctural design and discuss their decisions constru	ctively in a group.	
Autonomy	Students are capable to design independently different structural areas of the ship hull and different ship types and to define appropriate fabrication methods.			
Workload in Hours	Independent Study Time 172, Study Time	in Lecture 98		
Workload in Hours Credit points		in Lecture 98		
	s 9	in Lecture 98		
Credit points	s 9 t None	in Lecture 98		
Credit points Course achievement Examination Examination duration and	s 9 Vone Written exam S hours	in Lecture 98		
Credit points Course achievement Examination Examination duration and scale	s 9 k None Written exam d 3 hours		ture: Compulson	
Credit points Course achievement Examination Examination duration and	s 9 Vritten exam Vritten exam Solution General Engineering Science (German pro	: in Lecture 98 ogram, 7 semester): Specialisation Naval Architec gram, 7 semester): Specialisation Naval Architect		

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 Oroduction-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

Course L0415: Ship Structural Design	
Тур	Recitation Section (small)
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

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	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				
Fitle		Тур	Hrs/wk	СР
ntroduction to Control Systems (L	(654)	Lecture	2	4
ntroduction to Control Systems (L	655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and fre	equency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	 Students can represent dynamic system behaviore 	vior in time and frequency domain, and	can in particular	explain properties
	first and second order systems			
	 They can explain the dynamics of simple contr 	ol loops and interpret dynamic propertie	s in terms of free	quency response a
	root locus			
	They can explain the Nyquist stability criterion			
	 They can explain the role of the phase margin They can explain the way a PID controller affect 	, , ,		
	They can explain the way a PD controller affect They can explain issues arising when controller		5 1	digitally
			i e inipieriteiteu	argreatry
Skills	 Students can transform models of linear dynamic 	nic systems from time to frequency dom	ain and vice vers	a
	They can simulate and assess the behavior of s			
	They can design PID controllers with the help of	f heuristic (Ziegler-Nichols) tuning rules		
	 They can analyze and synthesize simple control 	ol loops with the help of root locus and fr	equency respons	e techniques
	 They can calculate discrete-time approximation 	ations of controllers designed in con	tinuous-time an	d use it for digi
	implementation They can use standard software tools (Matlab (Control Toolbox, Simulink) for corruing o	it those tasks	
	 They can use standard software tools (Matlab 0 	control roolbox, simulink) for carrying of	ut these tasks	
Personal Competence				
Social Competence	Students can work in small groups to jointly solve tec	hnical problems, and experimentally vali	date their contro	oller designs
Autonomy	Students can obtain information from provided sour	rces (lecture notes, software document	ation, experimen	nt guides) and use
	when solving given problems.			
	when solving given problems. They can assess their knowledge in weekly on-line te:	sts and thereby control their learning pro	ogress.	
		sts and thereby control their learning pro	ogress.	
		sts and thereby control their learning pro	ogress.	
		sts and thereby control their learning pro	ogress.	
Workload in Hours			ogress.	
Workload in Hours Credit points	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture		ogress.	
	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 5		gress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 5		ogress.	
Credit points Course achievement	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 1 6 None Written exam		ogress.	
Credit points Course achievement Examination	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 1 6 None Written exam		ogress.	
Credit points Course achievement Examination Examination duration and	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 1 6 None Written exam	56	ogress.	
Credit points Course achievement Examination Examination duration and scale	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 9 6 None Written exam 120 min	56 mester): Core qualification: Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 9 6 None Written exam 120 min General Engineering Science (German program, 7 ser	56 mester): Core qualification: Compulsory ry	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 9 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture ! 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Matl Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture ! 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Matt Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification:	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 1 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulsor Computer Science: Specialisation Computational Matt Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer	ring: Compulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 1 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulsor Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): 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-line term Independent Study Time 124, Study Time in Lecture 1 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulsor Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Civil Engineering: nester): Specialisation Bioprocess Engine	ring: Compulsory Compulsory ering: Compulsol	ry
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line ter Independent Study Time 124, Study Time in Lecture 1 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulsor Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineer nester): Specialisation Civil Engineering: nester): Specialisation Bioprocess Engine nester): Specialisation Energy and Enviro	ring: Compulsory Compulsory ering: Compulsoi mental Engineer	ry
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line term Independent Study Time 124, Study Time in Lecture 1 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulsor Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineering: nester): Specialisation Civil Engineering: nester): Specialisation Bioprocess Engine nester): Specialisation Energy and Enviro nester): Specialisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineer : Compulsory	ry ing: Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	They can assess their knowledge in weekly on-line term Independent Study Time 124, Study Time in Lecture 1 6 None Written exam 120 min General Engineering Science (German program, 7 ser Bioprocess Engineering: Core qualification: Compulso Computer Science: Specialisation Computational Math Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 ser General Engineering Science (English program, 7 ser	56 mester): Core qualification: Compulsory ry hematics: Elective Compulsory , ation: Compulsory nester): Specialisation Electrical Engineering: nester): Specialisation Civil Engineering: nester): Specialisation Bioprocess Engine nester): Specialisation Energy and Enviro nester): Specialisation Computer Science	ring: Compulsory Compulsory ering: Compulsor mental Engineer : Compulsory	ry ing: Compulsory
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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 plots
	Root locus design of PID controllers
	Frequency response techniques
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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 equationsTustin 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	o Control Systems
Тур	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Herbert Werner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

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Courses				
Title		Тур	Hrs/wk	СР
Computational Fluid Dynamics I (L(Computational Fluid Dynamics I (L(Lecture Recitation Section (large)	2	3 3
		Neclation Section (large)	2	5
Module Responsible				
Admission Requirements Recommended Previous	None			
Knowledge	 Mathematical Methods for Engineers 			
Knowledge	 Fundamentals of Differential/integral calculus 	and series expansions		
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
-	The students are able to list the basic numerics of pa	artial differential equations.		
	·····			
Skills	The students are able develop appropriate numerica	al integration in space and time for the go	overning partial d	ifferential equatior
	They can code computational algorithms in a structu	ured way.		
Personal Competence				
	The students can arrive at work results in groups an	d document them		
boelar competence				
Autonomy	The students can independently analyse approaches	s to solving specific problems.		
	· · · · · · · · · · · · · · · · · · ·	S		
Westlesed to Decom	Index and act Charles Times 124. Charles Times in Learning	50		
	Independent Study Time 124, Study Time in Lecture	56		
Credit points Course achievement	6			
Examination	None Written over			
Examination duration and	2h			
scale	211			
	General Engineering Science (German program, 7 so	emester): Specialisation Mechanical Engli	peering Focus Th	eoretical Mechanic
Following Curricula	Engineering: Elective Compulsory	emester). Specialisation Mechanical Engli	icering, rocus m	corectear meename
· · · · · · · · · · · · · · · · · · ·	General Engineering Science (German program, 7	7 semester): Specialisation Mechanical	Engineering, Foc	us Aircraft Syster
	Engineering: Elective Compulsory		5 5,	- ,
	General Engineering Science (German program, 7	semester): Specialisation Mechanical	Engineering, Foc	us Energy System
	Elective Compulsory			
	General Engineering Science (German program, 7 se	emester): Specialisation Naval Architectur	e: Compulsory	
	General Engineering Science (German program, 7 se	emester): Specialisation Energy and Envir	omental Engineer	ring: Compulsory
	Energy Systems: Technical Complementary Course (
	General Engineering Science (English program, 7 se			
	General Engineering Science (English program, 7	semester): Specialisation Mechanical I	ngineering, Foci	us Energy System
	Elective Compulsory	mester). Specialization Naval Architecture	Compulsory	
	General Engineering Science (English program, 7 se General Engineering Science (English program, 7	•		us Aircraft Sveto
	Engineering: Elective Compulsory	semester). Specialisation Mechallical	Lingineering, POC	us Antiant System
	Mechanical Engineering: Specialisation Energy Syste	ems: Elective Compulsory		
	Mechanical Engineering: Specialisation Aircraft Syste			
	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	al Fluid Dynamics I
Тур	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Rung
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Title		Тур	Hrs/wk	СР
Ship Dynamics (L0352)		Lecture	2	3
Ship Dynamics (L1620)		Recitation Section (small)	1	1
statistics and Stochastic Processes	in Naval Architecure and Ocean Engineering (L0364)	Lecture	2	3
Module Responsible	Prof. Moustafa Abdel-Maksoud			
Admission Requirements	None			
Recommended Previous Knowledge	 Technical mechanics Linear algebra, analysis, complex numbers Fluid mechanics 			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	 The students are able to give an overview over variou procedure of the manoeuvres. 	s manoeuvres. They can name applica	ation goals and t	hey can describe t
	- The students are able to give an overview over varius	rudder types. They can name criteria i	n the rudder des	ign.
	- The students can name computation methods which a	re used to determine forces and motio	ns in waves.	
Skills	 The students can come up with the equations of motio The students are able to determine hydrodynamic coe 			e and linearise the
	- The students can explain how a rudder works and they	can explain the physical effects whicl	n can occur.	
	- The students can mathematically describe waves.			
	- The students can explain the mathematically descripti	on of harmoncial motions in waves and	d they can deter	mine them.
Personal Competence				
Social Competence	- The students can arrive at work results in groups and	document them.		
	- The students can discuss in groups and explain their p	oint of view.		
Autonomy	- The students can assess their own strengthes and wea	knesses and the define further work s	teps on this basi	s.
Workload in Hours	Independent Study Time 140, Study Time in Lecture 70			
Credit points	7			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the	General Engineering Science (German program, 7 seme	ster): Specialisation Naval Architecture	e: Compulsory	

ourse 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
	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
	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
	Eong-territ distribution of sedway influences
Literature	
Literature	Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universit
	Hamburg-Harburg, 2014
	Abdul Malana d. M. Shia Danamin Jacker and Jacker (a Shid Danamin and Shia Thana Jacker Using the
	Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship Theory, Hamburg University Technology 2014
	Technology, 2014
	Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House - Jordan Hill, Oxford, United and American States and
	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 a
	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
	, ,

Course L1620: Ship Dynamic	S
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

	Stochastic Processes in Naval Architecure and Ocean Engineering
Тур	Lecture
Hrs/wk	
СР	
	Independent Study Time 62, Study Time in Lecture 28
	Dr. Sven Wassermann
Language	
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

Title Resistance and Propulsion (L1265) Resistance and Propulsion (L1266) Module Responsible Prof. Stefan Krüger Admission Requirements None Recommended Previous • Mechanics Knowledge • Fluid Dynamics for Naval Architects • Hydrostratics • Hydrostratics Educational Objectives After taking part successfully, students have reached the fermomena and their practical applications to hullform de of the course. Furthermore, environmental additional resist their application to full scale ships. This hold also for prog Main Focus is how hull forms can be optimized for minimur - Stillwater/added resistance, Wave resistance, Minimiza laminar/turbulent flow separation, Hull form design for resistance law,form factor method, thrust deduction, wake	ance and propulsion of ships are esign as well as numerical and emp istances are dealt with. The course ppulsion and hullefficiency elements m and sustainable fuel consumption ation of wave resistance, numerica redcude flow separation, Appenda	pirical prediction of e includes model s, mainly thrust of n. The following to al prediction me age Design and o	methods are subj test techniques a deduction and wa opics are dealt wit thods, friction law resistance, Froude
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			a properier tests a
propeller basics, propulsion tests, full scale speed power	-	-	
EEDI, speed trials, contractual matters concerning speed/p			
Chille The student shall leave to design competitive hull forme wi	ith respect to fuel consumption by		
Skills The student shall learn to design competitve hull forms wi evaluate these hulls by several progosis methods. Fur			
minimize the required power including environmental influ		the student to ci	lean determine a
minimize the required power melduling environmental initia	lences.		
Personal Competence			
Social Competence The student learns to prepare technical matters in such a v	way that he can compte with his bui	ilding suvervision	n team.
Autonomy The student learns to prepare technical matters in such a v	way that he can compte with his bui	ilding suvervision	n team.
Workload in Hours Independent Study Time 124, Study Time in Lecture 56			
Credit points 6			
Course achievement None			
Examination Written exam			
Examination duration and 180 min			
scale			
Assignment for the General Engineering Science (German program, 7 semester	er): Specialisation Naval Architecture	e: Compulsory	
Following Curricula General Engineering Science (English program, 7 semester	r): Specialisation Naval Architecture	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		

Course 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	

ourses				
itle		Тур	Hrs/wk	СР
hip Design (L1262)		Lecture	2	3
hip Design (L1264)		Recitation Section (large)	2	3
Module Responsible	Prof. Stefan Krüger			
Admission Requirements	None			
Recommended Previous	 Fluid Dynamics for Naval Architects, Res 	istance and Propulsion		
Knowledge	Resistance and Propulsion, Hydrostatics			
Educational Objectives	After taking part successfully, students have re	aschod the following learning results		
Professional Competence	Arter taking part successfully, students have re			
<i>Knowledge</i>	The lecture starts with an overview about the Ship Designs are thoroughly discussed. Typical main parameters of a ship are introduced an influence of alternated main parameters on th lecture, the design changes are dealt with the systems properly so that the relavent technical The lecture continues with an introduction introduced to ge during the different design stages. In detail, the - Structure of a building specification - Determination of Light Ship Weight and Dead Components - Design of main section and hull form	bulding contracts and the related technical d their influence on the competitiveness of e total performance of a ship design and th by simple models or formulae. The studen l conclusions can be drawn. o the different phases of design project, fro generate bulding specfication relevant inform e following topics are adressed: weight	risk are introduced a design. The lec e consecutive proc t shall further lear m the initial design	. The most importa ture focusses on f cess elements. In t n to model comp n phase to a build
Skills	 Design of aftbody lines and manoevering dev Design of main propulsion plant Design of subdivision Determination of limiting GMrequ- Curves Scantlings of most improtant structural memilier Longitudinal strength Outfitting Components Relevant rules and regulations The student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with the basic of the student is made familiar with t	pers	ips. The goal of th	ne lecture is that t
	student shall be able to carry out a concept de the Marine Environment. The lecture deals wit of a ship design with respect to fulfillment pro relevant methods to determine and judge uppr	esign based on a vessel of comparison fulfill h the basic design methods to determine th cedures of the contract values. Based on th	ing typical contract le fundamantal tec e lecture "Principle	t requirements wit hnical characterist
Personal Competence				
Social Competence	The students learns to prepare technical m	atters in such a way the he can persua	de his potantial c	ustomer against
Autonomy	competitors. The students learns to prepare technical m competitors.	natters in such a way the he can persua	de his potantial c	ustomer against
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
	180 min			
scale	Concerned Employeering Colonger (C		Carrow	
Assignment for the Following Curricula	General Engineering Science (German program General Engineering Science (English program			

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

Course L1264: Ship Design		
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		

Courses	
Fitle	
Management Tutorial (L0882)	Typ Hrs/wk CP Recitation Section (small) 2 3
ntroduction to Management (L088	
Module Responsible	Prof. Christoph Ihl
Admission Requirements	
Recommended Previous	
Knowledge	busic knowledge of Mathematics and business
	After taking part successfully, students have reached the following learning results
Professional Competence	
-	After taking this module, students know the important basics of many different areas in Business and Management, from Plant and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to
	 explain the differences between Economics and Management and the sub-disciplines in Management and to naimportant definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprine projects describe and explain basic business functions as production, procurement and sourcing, supply chain management
	 organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to c out an Entrepreneurship project in a team. In particular, they are able to
	 analyse Management goals and structure them appropriately
	 analyse organisational and staff structures of companies
	 apply methods for decision making under multiple objectives, under uncertainty and under risk
	analyse production and procurement systems and Business information systems
	analyse and apply basic methods of marketing
	 select and apply basic methods from mathematical finance to predefined problems
	 apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to
	work successfully in a team of students
	 to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project
	to communicate appropriately and
	 to cooperate respectfully with their fellow students.
Autonomy	Students are able to
	 work in a team and to organize the team themselves
	 to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
	Subject theoretical and practical work
	several written exams during the semester
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Core gualification: Compulsory
	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory
	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Computer Science: Core qualification: Compulsory
	Data Science: Core qualification: Compulsory
	Electrical Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess 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 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 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 Biomechan
	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 Biomechar 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 Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechar Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste

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 in Hours	Independent Study Time 62, Study Time in Lecture 28
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.

Lecturer Prof. Christoph Ihl, Prof. Herstatt, Prof. Wolfgam Language DE Cycle WiSe/SoSe Content Introduction to E Important definit Developing Obje Business Function Management Definitions as inf Definitions as inf Definition and R Relevance of ma different techniq important organ basics of human Introduction to A Relevance of Co Important aspect Literature Bamberg, G., Coenenberg Literature Bamberg, G., Coenenberg Pellens, B., Fülbier, R. U			
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Eisenführ, F., Weber, M Heinhold, M.: Buchführ Kruschwitz, L.: Finanzm Pellens, B., Fülbier, R. U Schweitzer, M.: Planum	Business and Management, Business versus Economics, relevant areas in Business and Management tions from Management, ectives for Business, and their relation to important Business functions ons: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovatio larketing and Sales Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informatio formation, information systems, aspects of data security and strategic information systems elevance of innovations, e.g. innovation opporunities, risks etc. arketing, B2B vs. B2C-Marketing ques from the field of marketing (e.g. scenario technique), pricing strategies izational structures ressource management Business Planning and the steps of a planning process is: Elements of decision problems and methods for solving decision problems ng Tasks, e.g. Investment and Financial Decisions Accounting: Accounting, Balance-Sheets, Costing introlling and selected Controlling methods cts of Entrepreneurship projects		
Kruschwitz, L.: Finanzm Pellens, B., Fülbier, R. L Schweitzer, M.: Planun	erg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 1.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003		
Pellens, B., Fülbier, R. L Schweitzer, M.: Planun	rung in Fallbeispielen, 10. Aufl., Stuttgart 2006.		
Schweitzer, M.: Planun	nathematik. 3. Auflage, München 2001.		
	U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008.		
5	ng und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Au		
Weber, J., Schäffer, U. :	: Einführung in das Controlling, 12. Auflage, Stuttgart 2008.		
Weber, J./Weißenberge	r, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.		

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 Process Engin	eering and Material Engineering		
Courses				
Title Introduction into Process Engineeri Fundamentals of material engineer		Typ Lecture Lecture	Hrs/wk 2 2	CP 1 2
Module Responsible		Lecture		2
Admission Requirements	None			
Recommended Previous				
Knowledge	lione			
	After taking part successfully, student	ts have reached the following learning results		
Professional Competence				
-	After passing this module the student	s have the ability to:		
5				
		nportant fields on process and bioprocess engine	ering,	
	 explain some working methods 	s for different fields in process engineering.		
Skills	After passing this module the student	s should have the ability to:		
		tant fields of process engineering,		
		ing approaches or methods of the different fields	s of process engineering,	
	 read and prepare an engineering of the second second			
		hnologies for wastewater and exhaust air treatm		
	 scheme typical chemical and b 	iotechnological processes independently with the	a ald of pointers.	
Personal Competence				
Social Competence	The students are able to			
	work out results in groups and			
	 provide appropriate feedback a 	and handle feedback on their own performance c	onstructively.	
Autonomy		eir progress of learning by themselves and to o	Jeliberate their lack of kr	nowledge in Process
	Engineering and Bioprocess Engineeri	ing.		
Workload in Hours	Independent Study Time 34, Study Tir	me in Lecture 56		
Credit points				
Course achievement		Description		
course achievement	No 5% Written elabor	ation		
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	General Engineering Science (German	n program, 7 semester): Specialisation Process E	ngineering: Compulsorv	
Following Curricula		n program, 7 semester): Specialisation Bioproces		ry
	Bioprocess Engineering: Core qualifica		5 5	-
		program, 7 semester): Specialisation Bioprocess	Engineering: Compulsor	v
		program, 7 semester): Specialisation Process En		
	Orientierungsstudium: Core qualificat		5 - 5	
	Process Engineering: Core qualificatio			

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

Course L0830: Fundamentals of material engineering			
Тур	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		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 rea	ached the following learning results		
Professional Competence				
Knowledge	This module deals with the foundations of the programming down to gates. The module includ • Introduction			in the assembly-h
	Sequential logic: Flip-flops, automata, sysTechnological foundations		ombinational net	works
	 Computer arithmetic: Integer addition, su Basics of computer architecture: Program Memories: Memory hierarchies, SRAM, DF 	ming models, MIPS single-cycle architecture,	pipelining	
		the CPU, principles of passing data, point-to-	point connections	, busses
Skills	The students perceive computer systems from t composition of computer systems. The students	can analyze, how highly specific and individ	ual computers ca	n be built based o
	collection of few and simple components. They today's computing systems - from gates and cir		lain the different	abstraction layer
	After successful completion of the module, the system and the software executed on it. In part on the hardware-centric abstraction layers from the impact that these low abstraction levels have	icular, they shall understand the consequent the assembly language down to gates. This	ces that the exect way, they will be	ution of software enabled to evalu
Personal Competence				, peronon
	Students are able to solve similar problems alor	e or in a group and to present the results acc	cordingly.	
Autonomy	Students are able to acquire new knowledge fro	m specific literature and to associate this kno	wledge with othe	r classes.
Workload in Hours	Independent Study Time 124, Study Time in Leo	ture 56		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	Yes 10 % Excercises			
Examination				
	90 minutes, contents of course and labs			
scale		7 Constantion Computer Color		
	General Engineering Science (German program, General Engineering Science (German program,			
Following Curricula	General Engineering Science (German program, General Engineering Science (German program,			лу
	General Engineering Science (German program,			A.
	General Engineering Science (German program,			y
	Selected Engineering Selected (Selected program,			orv
	General Engineering Science (German program.	7 semester): Specialisation Energy and Envi		
	General Engineering Science (German program, General Engineering Science (German program,		romental Enginee	
	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German progr	7 semester): Specialisation Process Enginee	romental Enginee ring: Compulsory	ring: Compulsory
	General Engineering Science (German program,	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanic	romental Enginee ring: Compulsory al Engineering,	ring: Compulsory Focus Mechatror
	General Engineering Science (German program, General Engineering Science (German progr Compulsory	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanic am, 7 semester): Specialisation Mechanica	romental Enginee ring: Compulsory al Engineering, I al Engineering, F	ring: Compulsory Focus Mechatror Focus Biomechar
	General Engineering Science (German program, General Engineering Science (German progr Compulsory General Engineering Science (German progr Compulsory	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanic am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical	romental Enginee ring: Compulsory al Engineering, f al Engineering, for Engineering, For	ring: Compulsory Focus Mechatror Focus Biomechar tus Aircraft Syste
	General Engineering Science (German program, General Engineering Science (German progr Compulsory General Engineering Science (German progr Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Sciences: Compulsory	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanic am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechani	romental Enginee ring: Compulsory al Engineering, 1 al Engineering, f Engineering, Foo cal Engineering,	ring: Compulsory Focus Mechatror Focus Biomechar Lus Aircraft Syst Focus Materials
	General Engineering Science (German program, General Engineering Science (German progr Compulsory General Engineering Science (German progr Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechani 7 semester): Specialisation Mechanical Engi	romental Enginee ring: Compulsory al Engineering, I al Engineering, F Engineering, Foo cal Engineering, neering, Focus Th	ring: Compulsory Focus Mechatror Focus Biomechar Lus Aircraft Syste Focus Materials Reoretical Mechar
	General Engineering Science (German program, General Engineering Science (German program, 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 program Engineering: Compulsory General Engineering Science (German program Engineering: Compulsory	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechani , 7 semester): Specialisation Mechanical Engi	romental Enginee ring: Compulsory al Engineering, I Engineering, Foc cal Engineering, Foc cal Engineering, neering, Focus F gineering, Focus F	ring: Compulsory Focus Mechatron Focus Biomechan Rus Aircraft Syste Focus Materials Reoretical Mechan Product Developm
	General Engineering Science (German program, General Engineering Science (German program, 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 program, Engineering: Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program and Production: Compulsory	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi	romental Enginee ring: Compulsory al Engineering, I Engineering, Foc cal Engineering, Foc cal Engineering, neering, Focus F gineering, Focus F Engineering, Foc	ring: Compulsory Focus Mechatror Focus Biomechar cus Aircraft Syste Focus Materials neoretical Mechar Product Developm us Energy Syste
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	General Engineering Science (German program, General Engineering Science (German program, 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 program, Engineering: Compulsory General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German program, and Production: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Computer Science: Core qualification: Compulsor) Data Science: Core qualification: Elective Comp	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical ry semester): Specialisation Civil Engineering ry ulsory ulsory	romental Enginee ring: Compulsory al Engineering, F Engineering, Foc cal Engineering, Foc cal Engineering, Focus F gineering, Focus F Engineering, Focus Engineering, Foc	ring: Compulsory Focus Mechatron Focus Biomechan cus Aircraft Syst Focus Material: Product Developn us Energy Syste us Energy Syste
	General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German progra Engineering Science: German program Engineering Science: German program Engineering: Compulsory General Engineering Science (German program Engineering: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, Computer Science: Core qualification: Compulsor Data Science: Core qualification: Elective Compi Electrical Engineering: Core qualification: Compu	7 semester): Specialisation Process Enginee am, 7 semester): Specialisation Mechanica am, 7 semester): Specialisation Mechanica m, 7 semester): Specialisation Mechanical ram, 7 semester): Specialisation Mechanical Engi 7 semester): Specialisation Mechanical Engi , 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical Engi m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical ry ulsory ulsory 7 semester): Specialisation Electrical Engineer	romental Enginee ring: Compulsory al Engineering, F Engineering, Foc cal Engineering, Foc cal Engineering, Focus F gineering, Focus F Engineering, Focus Engineering, Foc Engineering, Foc	ring: Compulsory Focus Mechatror Focus Biomechar tus Aircraft Syste Focus Materials Product Developm us Energy Syste us Energy Syste

1	Consul Environments Colores (Earlish answers 7 competent). Considiration Environmental Environmental Environmental
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental 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
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	Course L0324: Computer Engineering	
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Heiko Falk	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title			Тур	Hrs/wk	СР
Bioprocess Engineering - Fundamentals (L0841)		Lecture	2	3	
Bioprocess Engineering- Fundamentals (L0842)		Recitation Section (large)	2	1	
Bioprocess Engineering - Fundame			Practical Course	2	2
Module Responsible					
Admission Requirements	None				
Recommended Previous	none, module "organic chem	istry", module "fundamer	ntals for process engineering"		
Knowledge					
Educational Objectives	After taking part successfull	y, students have reached	the following learning results		
Professional Competence					
Knowledge	Students are able to describ	e the basic concepts of b	ioprocess engineering. They are able t	o classify different	t types of kinetics
	enzymes and microorganis	ms, as well as to differe	entiate different types of inhibition.	The parameters o	of stoichiometry a
	rheology can be named ar	d mass transport proces	sses in bioreactors can be explained.	The students are	e capable to expl
	fundamental bioprocess mai	nagement, sterilization ter	chnology and downstream processing i	in detail.	
CL:II-		- fabie	descaled by a shale by		
Skills	After successful completion	of this module, students s	snould be able to		
	describe different kin	etic approaches for growt	h and substrate-uptake and to calculat	e the correspondir	ng parameters
	 predict qualitatively 	the influence of energy of	generation, regeneration of redox equ	vivalents and grov	wth inhibition on
	fermentation process				
	 analyze bioprocesses 	on basis of stoichiometry	and to set up / solve metabolic flux eq	uations	
	 distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic 				
	to compare them as well as to apply them to current biotechnical problem				
	 propose solutions to complicated biotechnological problems and to deduce the corresponding models 				
	 to explore new knowledge resources and to apply the newly gained contents 				
	 identify scientific problems with concrete industrial use and to formulate solutions. 				
	 to document and disc 	uss their procedures as w	ell as results in a scientific manner		
Personal Competence					
•	After completion of this mod	dule participants should b	e able to debate technical questions ir	n small teams to e	nhance the ability
Social Competence			capacity for teamwork in engineering a		
Autonomy	After completion of this mod	dule participants will be a	ble to solve a technical problem in a t	eam independentl	y by organizing th
Autonomy	After completion of this mod workflow and to present the		ble to solve a technical problem in a t	eam independentl	y by organizing th
	workflow and to present the	eir results in a plenum.		eam independentl	y by organizing th
Workload in Hours	workflow and to present the Independent Study Time 96,	eir results in a plenum.		eam independentl	y by organizing th
Workload in Hours Credit points	workflow and to present the Independent Study Time 96, 6	eir results in a plenum. Study Time in Lecture 84	4	eam independent!	y by organizing th
Workload in Hours	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form	eir results in a plenum. . Study Time in Lecture 84 De		eam independentl	y by organizing th
Workload in Hours Credit points	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje	eir results in a plenum. Study Time in Lecture 84 De ect theoretical and	4	eam independentl	y by organizing th
Workload in Hours Credit points Course achievement	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract	eir results in a plenum. . Study Time in Lecture 84 De	4	eam independentl	y by organizing th
Workload in Hours Credit points Course achievement Examination	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam	eir results in a plenum. Study Time in Lecture 84 De ect theoretical and	4	eam independent!	y by organizing th
Workload in Hours Credit points Course achievement	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam	eir results in a plenum. Study Time in Lecture 84 De ect theoretical and	4	eam independentl	y by organizing th
Workload in Hours Credit points Course achievement Examination Examination duration and scale	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min	eir results in a plenum. , Study Time in Lecture 84 De ect theoretical and cical work	; scription		y by organizing th
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science	eir results in a plenum. , Study Time in Lecture 84 ect theoretical and cical work e (German program, 7 sen	scription nester): Specialisation Process Enginee	ring: Compulsory	
Workload in Hours Credit points Course achievement Examination Examination duration and scale	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science	eir results in a plenum. , Study Time in Lecture 84 ect theoretical and cical work e (German program, 7 sen e (German program, 7 sen	scription nester): Specialisation Process Enginee nester): Specialisation Bioprocess Engi	ring: Compulsory	
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science Bioprocess Engineering: Cor	eir results in a plenum. , Study Time in Lecture 84 ect theoretical and cical work e (German program, 7 sen e (German program, 7 sen e qualification: Compulsor	scription nester): Specialisation Process Enginee nester): Specialisation Bioprocess Engi ry	ring: Compulsory neering: Compulso	pry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science Bioprocess Engineering: Cor General Engineering Science	eir results in a plenum. , Study Time in Lecture 84 ect theoretical and cical work e (German program, 7 sen e (German program, 7 sen e qualification: Compulsor e (English program, 7 sem	scription nester): Specialisation Process Enginee nester): Specialisation Bioprocess Engi ry ester): Specialisation Bioprocess Engin	ring: Compulsory neering: Compulsor	pry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science Bioprocess Engineering Science General Engineering Science General Engineering Science	eir results in a plenum. , Study Time in Lecture 84 performation of the sector of th	scription nester): Specialisation Process Enginee nester): Specialisation Bioprocess Engi ry ester): Specialisation Bioprocess Engin ester): Specialisation Process Engineer	ring: Compulsory neering: Compulsor ieering: Compulsor ing: Compulsory	pry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science Bioprocess Engineering: Cor General Engineering Science Bioprocess Engineering Science Biomedical Engineering Science	eir results in a plenum. , Study Time in Lecture 84 performation of the sector of th	scription nester): Specialisation Process Enginee nester): Specialisation Bioprocess Engin ry lester): Specialisation Bioprocess Engin lester): Specialisation Process Engineer is and Regenerative Medicine: Compul-	ring: Compulsory neering: Compulsor ieering: Compulsor ing: Compulsory	pry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science Bioprocess Engineering: Cor General Engineering Science Bioprocess Engineering Science Biomedical Engineering Science Biomedical Engineering: Spe Biomedical Engineering: Spe	eir results in a plenum. Study Time in Lecture 84 December 2015 e (German program, 7 sen e (German program, 7 sen e qualification: Compulsor e (English program, 7 sem e (English program, 7 sem e cialisation Artificial Organ ecialisation Implants and E	scription secription nester): Specialisation Process Engineer nester): Specialisation Bioprocess Engin ry rester): Specialisation Bioprocess Engineer is and Regenerative Medicine: Compuls Endoprostheses: Elective Compulsory	ering: Compulsory neering: Compulso eering: Compulsory ing: Compulsory sory	pry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science Bioprocess Engineering: Cor General Engineering Science Biomedical Engineering: Spe Biomedical Engineering: Spe Biomedical Engineering: Spe	eir results in a plenum. Study Time in Lecture 84 December 2015 e (German program, 7 sen e (German program, 7 sen e qualification: Compulsor e (English program, 7 sem e (English program, 7 sem e cialisation Artificial Organ ecialisation Implants and E ecialisation Medical Technological Technological ecialisation Medical Technological	scription scription nester): Specialisation Process Engineer nester): Specialisation Bioprocess Engin ry rester): Specialisation Bioprocess Engineer is and Regenerative Medicine: Compuls Endoprostheses: Elective Compulsory ology and Control Theory: Elective Com	ering: Compulsory neering: Compulsor eering: Compulsory ing: Compulsory sory npulsory	pry
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	workflow and to present the Independent Study Time 96, 6 Compulsory Bonus Form Yes 5 % Subje pract Written exam 90 min General Engineering Science General Engineering Science Bioprocess Engineering: Cor General Engineering Science Biomedical Engineering: Spe Biomedical Engineering: Spe Biomedical Engineering: Spe	eir results in a plenum. Study Time in Lecture 84 Dec ect theoretical and cical work e (German program, 7 sen e qualification: Compulsor e (English program, 7 sem e (English program, 7 sem e cicalisation Artificial Organ ecialisation Implants and E ecialisation Medical Techno ecialisation Management a	scription sector): Specialisation Process Engineer nester): Specialisation Bioprocess Engin vester): Specialisation Bioprocess Engin ester): Specialisation Process Engineer as and Regenerative Medicine: Compuls and Regenerative Medicine: Compuls and Control Theory: Elective Com and Business Administration: Elective Com and	ering: Compulsory neering: Compulsor eering: Compulsory ing: Compulsory sory npulsory	pry

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

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

Course L0843: Bioprocess En	gineering - 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
Fundamentals of Fluid Mechanics (I		Lecture	2	4
Fluid Mechanics for Process Engine		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Mathematics I+II+III			
Knowneuge	Technical Mechanics I+II			
	Technical Thermodynamics I+II			
	Working with force balances			
	 Simplification and solving of partial differential ed Integration 	luations		
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Students are able to:			
	explain the difference between different types of	flow		
	• give an overview for different applications of the	Reynolds Transport-Theorem in proce	ss engineering	
	explain simplifications of the Continuity- and Nav	ier-Stokes-Equation by using physical	boundary condit	ions
Skills	The students are able to			
		M 11 -		
	 describe and model incompressible flows mathem reduce the governing equations of fluid mechanic 		tativo colutions o	a by integration
	 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 applica 			
Personal Competence	The shudesh			
Social Competence	The students			
	 are capable to gather information from subject r 	elated, professional publications and	relate that inform	nation to the conte
	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 the 	emselves, to discuss the solutions ora	lly and to presen	t the results.
			,	
Autonomy	The students are able to			
	 search further literature for each topic and to expand their knowledge with this literature, 			
	 work on their exercises by their own and to evaluate 	ate their actual knowledge with the fe	eedback.	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement		iption		
	Yes 5 % Midterm			
Examination				
Examination duration and scale	3 nours			
	General Engineering Science (German program, 7 seme	ster): Specialisation Process Engineer	ing: Compulsory	
-	General Engineering Science (German program, 7 seme			prv
y cantala	General Engineering Science (German program, 7 seme			-
	Bioprocess Engineering: Core qualification: Compulsory			
	Energy and Environmental Engineering: Core qualification	on: Compulsory		
	General Engineering Science (English program, 7 semes			-
	General Engineering Science (English program, 7 semes			ing: Compulsory
	General Engineering Science (English program, 7 semes Technomathematics: Specialisation III. Engineering Scie		ng: Compulsory	
	recinorialitematics, specialisation III, enumeering Scie			

Course L0091: Fundamentals	s of Fluid Mechanics
Тур	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	 fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik. Künchen, Pearson Studium, 2007 Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course L0092: Fluid Mechani	ics for Process Engineering
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	 Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Courses				
Courses				
Title Phase Equilibria Thermodynamics (10114)	Typ Lecture	Hrs/wk 2	CP 2
Phase Equilibria Thermodynamics (Phase Equilibria Thermodynamics (Recitation Section (small)	1	2
Phase Equilibria Thermodynamics (Recitation Section (large)	1	2
Module Responsible				
Admission Requirements	None			
Recommended Previous	Mathematics, Physical Chemistry, Thermo	dynamics Land II		
Knowledge	mathematics, mysical chemistry, memo			
Educational Objectives	After taking part successfully, students ha	we reached the following learning results		
Professional Competence	Alter taking part successionly, students ha	the reaction the following learning results		
Knowledge				
Kilowieuge	Starting from the very basics of the second se	nermodynamics, the students learn the mathemat	ical tools to desc	cribe thermodyna
	equilibria.			
	They learn how state variables are	e influenced by the mixing of compounds and lear	n concepts to qu	antitatively desc
	these properties.			
	Moreover, the students learn how	phase equilibria can be described mathematically	and which pher	nomena may occu
	different phases (vapor, liquid, solid	d) coexist in equilibrium. Furthermore the fundament	ntals of reaction e	quilibria are taug
	 For different phase equilibria, sev 	eral examples relevant for different kinds of pro-	cesses are shown	n and the necess
	knowledge for plotting and interpre	ting the equilibria are taught.		
Skills				
		dents are able to identify the correct equation for	the determination	on of the equilibr
	state and know how to simplify these equations meaningfully.			
	The students know models which can be used to determine the properties of the system in the equilibrium state and the			
	are able to solve the resulting math			
		able to self-reliantly find necessary physico-chemic	al properties of c	ompounds as wei
	model parameters in literature sour			
		he students are capable of describing the propertie		
		phase equilibria graphically and they know how to		
		tudents are able to understand fundamental co	ncepts that are	the basis for m
	separation and reaction processes i	in chemical engineering.		
Devenuel Commetence				
Personal Competence	The shuddeness also be used in small m			
Social Competence		roups, to solve the corresponding problems and to	present them or	aly to the tutors
A	other students			
Autonomy	 The students are able to find neces 	sary information self-reliantly in literature sources	and to judge their	quality.
	 During the semester the students are able to check their learning progress continuously in exercises. Based on th 			
	knowledge the students can adept	their learning process.		
Meddeed	Independent Study Time 124 Charles T	in Locture F6		
Credit points	Independent Study Time 124, Study Time	III LECTURE 30		
Course achievement				
Examination	Written exam			
		leulations		
Examination duration and scale	120 minutes; theoretical questions and ca			
	General Engineering Science (German pro	gram, 7 semester): Specialisation Process Enginee	ing: Compulsory	
Following Curricula		gram, 7 semester): Specialisation Process Engineer		
. Showing curricula	Bioprocess Engineering: Core qualification			2
		gram, 7 semester): Specialisation Bioprocess Engine	ering: Compulso	rv
		gram, 7 semester): Specialisation Dioprocess Engineeri gram, 7 semester): Specialisation Process Engineeri		• 3

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

Course L0140: Phase Equilib	ria Thermodynamics
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE
Cycle	SoSe
Content	 Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure 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.

Тур	Recitation Section (large)	
Hrs/wk		
CP		
	Independent Study Time 46, Study Time in Lecture 14	
	Prof. Irina Smirnova	
Language		
Cycle		
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. Prentic Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997, J.P. O'Connell, J.M. Haile Thermodynamics. Cambridge University Press, 2005. 	

Courses				
Title		Тур	Hrs/wk	СР
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 have	ve reached the following learning results		
Professional Competence				
-	With completion of this module, the stude	ents can provide an overview of characteristics	of energy system	and their econo
Knowledge		urring in this context. Furthermore, they can exp		
		rd to subject-related contexts. The students		
		neral, especially for renewable energy systems	and critical discus	s them. Furtherm
	the students can explain the environmenta	al benefits from the use of such systems.		
Skills	Students are able to apply methodologies	for detailed determination of energy demand or	energy production	n for various type
	energy systems. Furthermore, they can ev	valuate energy systems technically, environment	ally and economic	ally and design th
	under certain given conditions. Therefo	re, they can choose the necessary subject-s	pecific calculation	rules, also for
	standardized solutions of a problem.			
	The students are able to explain question	s and possible approaches to its processing fror	n the field of rene	wable energies or
	and to put them them into the right contex	kt.		
Personal Competence				
Social Competence		e technical alternatives and to assess them wit		
	criteria under sustainability aspects. This a	llows them to make an effective contribuition to	a more sustainable	e power supply.
Autonomy	Students can independently exploit source	es , acquire the particular knowledge about the	a subject area and	transform it to
Autonomy		es, acquire the particular knowledge about the	e subject area and	
	questions.			
Workload in Hours	Independent Study Time 96, Study Time 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 prog	gram, 7 semester): Specialisation Energy and Env	/iromental Enginee	ring: Compulsory
Following Curricula	General Engineering Science (German prod	gram, 7 semester): Specialisation Process Engine	erina: Compulsory	
3	5 5	rogram, 7 semester): Specialisation Mechanica	5 , ,	rus Enerav Syste
	Elective Compulsory	rogram, / semester, specialisation mechanica	r Engliteering, roo	Lus Energy Syste
		regreen 7 competer). Creciplication Machanica		un Energy Custo
		rogram, 7 semester): Specialisation Mechanica	i Liigineering, Foo	us chergy syste
	Compulsory			
		cialisation Civil Engineering: Elective Compulsory		
	Civil- and Environmental Engineering: Spec	cialisation Traffic and Mobility: Elective Compulso	ry	
	Civil- and Environmental Engineering: Spec	cialisation Water and Environment: Elective Com	oulsory	
	Energy and Environmental Engineering: Co	pre qualification: Compulsory		
	General Engineering Science (English prog	ram, 7 semester): Specialisation Energy and Env	iromental Engineer	ing: Compulsory
		ogram, 7 semester): Specialisation Mechanica	-	
	Elective Compulsory		5 <u>9</u> , 100	3, 2,000
			ring. Elective Com	nulcony
	General Engineering Science (English prog Process Engineering: Core qualification: Co	ram, 7 semester): Specialisation Process Enginee	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 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 Cost and efficiency calculation 	
Literature	Folien der Vorlesung	

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

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

ourse L1434: Renewable Energy	
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	Typ Hrs/wk CP				
Signals and Systems (L0432) Signals and Systems (L0433)	Lecture 3 4 Recitation Section (small) 2 2				
Module Responsible					
Admission Requirements					
Recommended Previous					
Knowledge					
-	The modul is an introduction to the theory of signals and systems. Good knowledge in maths as covered by the moduls Mathema				
	1-3 is expected. Further experience with spectral transformations (Fourier series, Fourier transform, Laplace transform) is use				
	but not required.				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system				
	theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. The				
	can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, the				
	understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal t discrete-time signal.				
Skills	ascrete-time signal. The students are able to describe and analyse deterministic signals and linear time-invariant systems using methods of signal a				
JKIIIS	system theory. They can analyse and design basic systems regarding important properties such as magnitude and pha				
	response, stability, linearity etc They can assess the impact of LTI systems on the signal properties in time and frequency dom				
Personal Competence					
-	The students can jointly solve specific problems.				
	The students are able to acquire relevant information from appropriate literature sources. They can control their level				
	knowledge during the lecture period by solving tutorial problems, software tools, clicker system.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	None				
Examination					
Examination duration and	90 min				
scale					
	General Engineering Science (German program, 7 semester): Core qualification: Compulsory				
Following Curricula					
	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 Bioprocess Engineering: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan				
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy System				
	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 Materials in Engineer				
	Sciences: Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatroni				
	Compulsory				
	General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani				
	Engineering: 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 III. Engineering Science: Elective Compulsory				
Course L0432: Signals and S	ystems				
Тур	Lecture				
Hrs/wk					

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

Module M0892: Chem	ical Reaction Engineering				
Courses					
Courses					
Fitle		Тур	Hrs/wk	CP	
Chemical Reaction Engineering (Fu Chemical Reaction Engineering (Fu		Lecture Recitation Section (large)	2	2	
Experimental Course Chemical Eng		Practical Course	2	2	
Module Responsible	-		-	-	
Admission Requirements					
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence	After taking part successivily, students have r				
•	The students are able to explain basic concer	ats of chemical reaction engineering. They ar	e able to point out	differences betwe	
Kilowieuge	thermodynamical and kinetical processes. Th	5 5 ,			
	ideal reactors and to describe their properties		pures of isoenerma		
Skille					
JKIIIS	After successful completion of the module, students are able to:				
	- apply different computational methods to dimension isothermal and non-isothermal ideal reactors,				
	- determine and compute stable operation points for these reactors ,				
	determine and compare stable operation por	nes for these reactors,			
	- conduct experiments on a lab-scale pilot plants and document these according to scientific guidelines.				
Personal Competence					
	After successful completition of the lab-cours	e the students have a strong ability to organ	nize themselfes in «	small groups to so	
Social competence	After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to so issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and w				
	their teachers.	statents can alseass their subject related	chowledge aniong		
Διιτοποπγ		oformation and assess their relevance aut	tonomously Stude	nts can apply th	
Autonomy	The students are able to obtain further information and assess their relevance autonomously. Students can apply knowldene discretely to plan prepare and conduct experiments			into cuin appiy th	
Workload in Hours	knowldege discretely to plan, prepare and conduct experiments. Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	Compulsory Bonus Form Description				
course achievement	Yes None Subject theoretical	and			
	practical work				
Examination					
Examination duration and	120 min				
scale					
Assignment for the	General Engineering Science (German program	n, 7 semester): Specialisation Process Engine	ering: Compulsory		
Following Curricula	General Engineering Science (German program			ory	
-	Bioprocess Engineering: Core qualification: Co			-	
	General Engineering Science (English program		neering: Compulso	ry	
	General Engineering Science (English program				
	Green Technologies: Energy, Water, Climate: 9				
	Process Engineering: Core qualification: Comp		ie compulsory		
	rocess Engineering. core qualification. comp	alony			

Course L0204: Chemical Reaction Engineering (Fundamentals)			
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Raimund Horn		
Language	DE		
Cycle	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, 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 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, CSTR with
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 Rea	ction Engineering (Fundamentals)
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Raimund Horn, Dr. Oliver Korup
Language	DE
Cycle	WiSe
Content	Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)
	Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)
	Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy,

	enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers) Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0. 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics) Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactor, design of a membrane reactor, mole balance of the plug flow reactor, mole balance of a continuously stirred tank reactor, complex neattor, 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
	of a reactor)
Literature	lecture notes Raimund Horn
	ekript Fredich Keil
	skript Frerich Keil
	Books:
	Books:
	Books: M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
	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
	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
	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
	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
	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
	 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
	 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
	 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
	 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
	 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 D. Levenspiel, Chemical Reaction Engineering, Oxford Univ. Press, 2009 J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000

Course L0221: Experimental	Course Chemical Engineering (Fundamentals)			
Тур	Practical Course			
Hrs/wk	2			
CP				
Workload in Hours	ependent 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: Envir	onmental Tech	nology			
Courses					
Title			Тур	Hrs/wk	СР
Practical Exercise Environmental Technology (L1387)		Practical Course	1	1	
Environmental Technologie (L0326			Lecture	2	2
Module Responsible	Prof. Martin Kaltschm	nitt			
Admission Requirements					
Recommended Previous	Fundamentals of inor	rganic/organic chemistry	and biology		
Knowledge					
Educational Objectives	After taking part suc	cessfully, students have	reached the following learning results		
Professional Competence					
Knowledge	With the completion of this modul the students obtain profound knowledge of environmental technology. They are able to 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 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 presen and defend these opinons in front of and against the group.				
Personal Competence					
Social Competence	The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are at				
	to develop different a	approaches to the task a	s a group as well as to discuss their the	eoretical or practical imple	ementation.
Autonomy	Students can indepe	Students can independently exploit sources about of the subject, acquire the particular knowledge and tranfer it to new problems			
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			
Examination	Written exam				
Examination duration and	1 hour				
scale					
Assignment for the	General Engineering	Science (German progra	m, 7 semester): Specialisation Process	Engineering: Elective Cor	npulsory
Following Curricula					
			m, 7 semester): Specialisation Energy a	and Enviromental Enginee	ering: Compulsory
		ng: Core qualification: El			
			qualification: Compulsory		
			n, 7 semester): Specialisation Bioproce		
			n, 7 semester): Specialisation Energy a	-	
			n, 7 semester): Specialisation Process I	Engineering: 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	of. 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	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			

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Course L0326: Environmenta	l Technologie
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Martin Kaltschmitt, 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
ntroduction to Control Systems (L0	0654)	Lecture	2	4
ntroduction to Control Systems (L0	0655)	Recitation Section (small)	2	2
Module Responsible	Prof. Herbert Werner			
Admission Requirements	None			
Recommended Previous	Representation of signals and systems in time and	d frequency domain, Laplace transform		
Knowledge				
Educational Objectives	After taking part successfully, students have react	hed the following learning results		
Professional Competence				
Knowledge	 Students can represent dynamic system be 	abaylor in time and frequency domain, and	can in particular	ovalain proportios
	first and second order systems	enavior in time and nequency domain, and		explain properties (
	 They can explain the dynamics of simple co 	ontrol loops and interpret dynamic propertie	es in terms of free	quency response an
	root locus			
	 They can explain the Nyquist stability criter 	rion and the stability margins derived from i	t.	
	They can explain the role of the phase man			
	They can explain the way a PID controller a They can explain issues crising when control			diaitallu
	 They can explain issues arising when control 	ollers designed in continuous time domain a	are implemented	digitally
Skills	 Students can transform models of linear dy 	namic systems from time to frequency dom	ain and vice vers	2
	 They can simulate and assess the behavior 			a
	They can design PID controllers with the he			
	They can analyze and synthesize simple co	ntrol loops with the help of root locus and fr	equency respons	e techniques
	 They can calculate discrete-time approx 	kimations of controllers designed in con	tinuous-time and	d use it for digit
	implementation			
	 They can use standard software tools (Matl 	ab Control Toolbox, Simulink) for carrying o	ut these tasks	
Personal Competence				
Social Competence	Students can work in small groups to jointly solve	technical problems, and experimentally val	idate their contro	ller designs
Autonomy	Students can obtain information from provided s	sources (lecture notes, software document	ation, experimen	t guides) and use
	when solving given problems.			
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pro	oaress.	
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pro	ogress.	
	They can assess their knowledge in weekly on-line	e tests and thereby control their learning pr	ogress.	
Werkland in Hours			ogress.	
	Independent Study Time 124, Study Time in Lectu		ogress.	
Credit points	Independent Study Time 124, Study Time in Lectu		ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lectu 6 None		ogress.	
Credit points Course achievement	Independent Study Time 124, Study Time in Lectu 6 None Written exam		ogress.	
Credit points Course achievement Examination	Independent Study Time 124, Study Time in Lectu 6 None Written exam		ogress.	
Credit points Course achievement Examination Examination duration and scale	Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min	ire 56	ogress.	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Independent Study Time 124, Study Time in Lectu 6 None Written exam 120 min General Engineering Science (German program, 7	semester): Core qualification: Compulsory	ogress.	
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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 			
	System type and steady-state error, error constants Internal model principle			
	Root locus techniques			
	Root locus plots Root locus design of PID controllers			
	Frequency response techniques			
	 Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation 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	urse L0655: Introduction to Control Systems		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Herbert Werner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M1497: Meas					
Courses					
Title			Тур	Hrs/wk	СР
Practical Course Measurement Tec	hnology (L2270)		Practical Course	2	2
Measurement Technology (L2268) Physical Fundamentals of Measure	ment Technology (122)	60)	Lecture Lecture	2	2 2
Module Responsible			Lecture	Z	2
Admission Requirements	None				
Recommended Previous		logical skills integral.	and differential calculus, basic physical con	cents such as temper	ature mass velocit
Knowledge		logical skins, integral	and amerendar calculas, basic physical con	icepts such us tempere	
Educational Objectives	After taking part su	ccessfully, students ha	ve reached the following learning results		
Professional Competence					
Knowledge	-		cs (theory of motion), rotation of rigid b	odies, energy and m	omentum, electrici
	magnetism, basics	of hydrodynamics, tem	perature and heat, ideal gas.		
	Metrology: SI units,	, measurement and m	easurement uncertainty, basics of sensor t	echnology, physical pr	inciples, temperatu
	measurement, pres	sure measurement, lev	el measurement, flow measurement. Usage	of Matlab scripts.	
	Practical course: Pr	essure drop in piping	calorimetry, image data acquisition, flow me	asurement concentrati	on measurement a
			of solid concentrations, spectroscopy, error c		
	mabb cranbier, capa			alcalación, en ornacogre	
Skills		Literature research, categorisation of thematical topics, analysis of an experimental test stand, preparation of test protocol, fi			
		Matlab, use of releva	ant laboratory measurement technology, p	reparation of a test p	rotocol, execution
	calculations.				
Personal Competence					
Social Competence	Arrangement and d	Arrangement and division of work in practical training and learning groups, assessment of own level of knowledge, work on the			
	experimental stand	d in groups, consulta	tion with persons responsible for teachin	g, presentation of the	e preparation of t
	experiment, toleran	ice of frustration			
Autonomy	Time management	of the workload inder	pendent development of the thematic basics	s personal responsibilit	v for the provision
Autonomy					
	protective equipment and work clothing, practice of presentation in front of a group, active participation formulation of enquiries/detailed questions by using clicker.				
Workload in Hours		Time 96, Study Time ir	n Lecture 84		
Credit points	1	Form	Description		
Course achievement	Compulsory Bonus No 20 %	Excercises	Description Popup-Quizzes währen der Vorlesu	na	
Examination	Written exam				
Examination duration and	1				
scale					
Assignment for the	General Engineering	g Science (German pro	gram, 7 semester): Specialisation Process Er	ngineering: Compulsory	
Following Curricula		- ,	gram, 7 semester): Specialisation Process Er		
	General Engineering	g Science (German pro	gram, 7 semester): Specialisation Bioproces	s Engineering: Compuls	ory
	General Engineering	g Science (German pro	gram, 7 semester): Specialisation Green Tec	hnologies: Compulsory	
	Bioprocess Enginee	ring: Core qualification	: Compulsory		
			ram, 7 semester): Specialisation Process En	gineering: Compulsory	
	-		te: Core qualification: Compulsory		
		: Core qualification: Ele			
	Process Engineering	g: Core qualification: Co	ompulsory		

Course L2270: Practical Cour	Course L2270: Practical Course Measurement Technology			
Тур	Practical Course			
Hrs/wk				
CP	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.			

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

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

Courses				
Title		Тур	Hrs/wk	СР
Thermal Separation Processes (L01		Lecture	2	2
Thermal Separation Processes (L01		Recitation Section (small)	2	2
Thermal Separation Processes (L01 Separation Processes (L1159)	41)	Recitation Section (large) Practical Course	1 1	1 1
	Prof. Irina Smirnova	Hactical course	Ŧ	Ŧ
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Recommended requirements: Thermodynamics III			
Educational Objectives Professional Competence	After taking part successfully, students have reached	the following learning results		
Knowledge				
	 The students can distinguish and describe d adsorption The students develop an understanding for the energy demand of a process, the possibilities o They have good knowledge of designing method 	e course of concentration during a sep f energy saving, and the selection of se	aration process, paration systems	the estimation of
Skills Personal Competence Social Competence Autonomy	 Using the gained knowledge the students can a close the associated energy and material balant. The students can use different graphical met theoretical stages required They can select and design a basic type of the disadvantages of the process The students are capable to obtain independe tables) They can calculate continuous and discontinuoi. The students are able to prove their theoretical colloquium. The students are capable of linking their gained know technical problems. Other lectures such as thermodyn. The students are able to carry out practical latter. They are able to discuss their results and them. They are able to obtain the needed The students are capable to be their theoretical assignments in the students are able to carry out practical latter. They are able to discuss their results and them. They are capable to obtain the needed The students can proof the state of their kn learning process 	ces hods for the designing of a separation hermal separation process for a giver htly the needed material properties fro us processes knowledge in the experimental lab wo al background and the content of the en- ledge with the content of other lectures hamics, fluid mechanics and chemical en- in small groups and present the combine b work in small groups and organize a l to document them scientifically in a re- information from suitable sources by th	on process and d in case based on om appropriate so rk. xperimental work s and use it toget ngineering. ed results in the t a functional divis aport.	lefine the amoun the advantages purces (diagrams a with the teacher her for the solutio utorial ion of labor betw seess their quality
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 minutes; theoretical questions and calculations			
scale				
Assignment for the Following Curricula	General Engineering Science (German program, 7 sen General Engineering Science (German program, 7 sen General Engineering Science (German program, 7 sen Compulsory General Engineering Science (German program, 7 sen Bioprocess Engineering: Core qualification: Compulsor Energy and Environmental Engineering: Core qualifica General Engineering Science (English program, 7 sem	nester): Specialisation Bioprocess Engin nester): Specialisation Green Technolog nester): Specialisation Energy and Envir Y tion: Elective Compulsory	neering: Compulso jies, Focus Renew romental Enginee	ory vable Energy: Elec ring: Compulsory
	General Engineering Science (English program, 7 sem General Engineering Science (English program, 7 sem Green Technologies: Energy, Water, Climate: Specialis Green Technologies: Energy, Water, Climate: Specialis Process Engineering: Core qualification: Compulsory	ester): Specialisation Process Engineeri sation Energy Systems: Elective Compu	ing: Compulsory Isory	ing: Compulsory

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

ourse L0119: Thermal Sepa	
<i>,</i> ,	Recitation Section (small)
Hrs/wk	
СР	
	Independent Study Time 32, Study Time in Lecture 28
	Prof. Irina Smirnova
Language	
Cycle	WiSe
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 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 198-Ullmann"s Enzyklopädie der Technischen Chemie

Тур	Recitation Section (large)
Hrs/wk	
CP	1
	- Independent Study Time 16, Study Time in Lecture 14
	Prof. Irina Smirnova
Language	
Cycle	
Content	 Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separati processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 198 Ullmann"s Enzyklopädie der Technischen Chemie

Course L1159: Separation Pr	ocesses
Тур	Practical Course
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Irina Smirnova
Language	DE/EN
Cycle	WiSe
Content	takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students.
	The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area.
	 Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation processes Advance overview of separation processes Selection of separation processes
Literature	 G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1 ; ISBN 0-387-91477-3 . R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie

Module M0538: Heat	and Mass Transfer
Courses	
Title	Typ Hrs/wk CP
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	None
Recommended Previous Knowledge	Basic knowledge: Technical Thermodynamics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Skills	 heat exchanger, chemical reactors). They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, he transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfe qualitative and quantitative by using suitable mass transfer theories. They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail. The students are able to set reasonable system boundaries for a given transport problem by using the gained knowled and to balance the corresponding energy and mass flow, respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical reactors, temperature alteration in fluic and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical processes or apparatus. They are able to distinguish between diffusion, convective mass transition and mass transfer. They can use this knowledge for the description and design of apparatus (e.g. extraction column), rectification column). In this context, the students are capable to choose and design fundamental types of heat and mass exchanger for a speci application considering their advantages and disadvantages, respectively. In addition, they can calculate both, steady-state and non-steady-state processes in procedural apparatus. The students are capable to connect their knowledge obtained in this course with knowledge of other courses of particular the courses thermodynamics, fluid mechanics and chemical process engineering) to solve concrete technic problems.
Personal Competence Social Competence	 The students are capable to work on subject-specific challenges in teams and to present the results orally in a reasonab manner to tutors and other students.
Autonomy	 The students are able to find and evaluate necessary information from suitable sources They are able to prove their level of knowledge during the course with accompanying procedure continuously (clicke system, exam-like assignments) and on this basis they can control their learning processes.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	
Examination	Written exam
	120 minutes; theoretical questions and calculations
	בבס חוווותנכס, נוכסופנוכמו קעפסנוסוס מווע כמוכעומנוסווס
scale	
Assignment for the	General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory
Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory
	General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
	Bioprocess Engineering: Core qualification: Compulsory
	Energy and Environmental Engineering: Core qualification: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
	Green Technologies: Energy, Water, Climate: Core qualification: Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective 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 Mass Transfer		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Irina Smirnova	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Module M1274: Envir				
Courses				
Title		Тур	Hrs/wk	СР
Environmental Assessment (L0860		Lecture	2	2
Environmental Assessment (L1054		Recitation Section (small)	1	1
Module Responsible	Prof. Martin Kaltschmitt			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic chemistry and bi	ology		
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
Knowledge	With the completion of this module the students environmental problems which might occur from pr about the methodological diversity and are competer impacts. Besides the students are able to estimate difficulties with their measurement.	roduction processes, projects or construction in dealing with different methods and	tion measures. instruments to	They have knowled assess environment
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 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 technic to develop jointly different solutions and to discus topics, the students receive insights into the multi- Their sensitivity and consciousness towards these social responsibilities in their role as engineers.	ss their theoretical or practical impleme ayered issues of the environment protec	entation. Due to tion and the con	the selected lectu cept of sustainabilit
Autonomy	The students learn to research, process and press scientific work. They can solve an environmental pro			
Workload in Hours	Independent Study Time 48, Study Time in Lecture	42		
Credit points				
Course achievement				
Examination				
Examination duration and scale	1 hour written exam			
Assignment for the	General Engineering Science (German program, 7 se	emester): Specialisation Process Engineer	ing: Elective Cor	npulsory
5	General Engineering Science (German program, 7 so General Engineering Science (German program, 7 so Bioprocess Engineering: Core qualification: Elective	emester): Specialisation Bioprocess Engin emester): Specialisation Energy and Envir Compulsory	eering: Elective	Compulsory
	Energy and Environmental Engineering: Core qualifi 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 Cor	mester): Specialisation Bioprocess Engine mester): Specialisation Process Engineeri mester): Specialisation Energy and Enviro	ng: Elective Com	npulsory

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
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
Particle Technology I (L0434)			Lecture		2	3
Particle Technology I (L0435)			Recitation Se	ction (small)	1	1
Particle Technology I (L0440)			Practical Cou	rse	2	2
Module Responsible	Prof. Stefan Heinrich	h				
Admission Requirements	None					
Recommended Previous	keine					
Knowledge						
Educational Objectives	After taking part su	ccessfully, students hav	e reached the following learning re	esults		
Professional Competence						
Knowledge	After successful con	mpletion of the module s	students are able to			
	 name and ex 	nlain processes and up	it-operations of solids process engi	ineering		
			outions and to discuss their bulk pr	-		
	endracterize	paraieles, paraiele alsan		operates		
Skills	Students are able to	D				
	 choose and d 	lesign apparatuses and	processes for solids processing acc	cording to the de	esired solids prop	erties of the produ
	 asses solids \ 	with respect to their beh	avior in solids processing steps			
	 document the 	eir work scientifically.				
Personal Competence						
	The students are a	blo to discuss scientifi	topics orally with other student	s or sciontific n	orconal and to	tovolon colutions
Social Competence	The students are able to discuss scientific topics orally with other students or scientific personal and to develop solutions for technical-scientific issues in a group.					
Διιτοποπγ			stions regarding solid particles ind	enendently		
, laconomy		o analyze and solve que	stono regaranto sona particles ma	ependentiji		
Workload in Hours	Independent Study	Time 110, Study Time i	n Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description		5 1 0 C 1	
	Yes None	Written elaboration	sechs Berichte (pro Versuo	ch ein Bericht) a	5-10 Seiten	
Examination						
Examination duration and	90 minutes					
scale						
Assignment for the	5		ram, 7 semester): Specialisation P			
Following Curricula			ram, 7 semester): Specialisation B			
	-		ram, 7 semester): Specialisation E		-	
	-		gram, 7 semester): Specialisation	Green lechnolog	gies, Focus Wate	r and Environment
	Engineering: Electiv					
		ring: Core qualification:				
			re qualification: Elective Compulso	-		
			am, 7 semester): Specialisation Bi			-
	-		am, 7 semester): Specialisation En		-	ing: Compulsory
	General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory					
	Green Technologies	s: Energy, Water, Climat	e: Specialisation Water: Elective Co	ompulsory		
	D	g: Core qualification: Co				

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

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

Title Typ Hrs/wk CP Process and Plant Engineering (10096) Lecture 2 2 Precess and Plant Engineering (10096) Recitation Section (large) 1 2 Precess and Plant Engineering (10096) Recitation Section (large) 1 2 Module Responsible Prof. Mito Skiborowski Recitation Section (large) 1 2 Admission Requirements None Indiagenering 1 2 Recommended Previous undiperation of thermal an direchanical separation processes - - Knowledge tudents can: classify and form: late label balance equations of chemical processes - - specify linear component equations of complex chemical processes expelial infear regression and data reconcillation problems - - skills students are capable of - - - - - formulation of data reconcillation tasks - - - - - - estimation of process synthesis - - - - - - - - -	Courses						
heess and Plant Engineering (10005) 2 2 heess and Plant Engineering (10005) Recitation Section (anal) 1 2 heess and Plant Engineering (10005) Recitation Section (anal) 1 2 heess and Plant Engineering (10005) Recitation Section (anal) 1 2 heess and Plant Engineering (10005) Recitation Section (anal) 1 2 heess and Plant Engineering (10005) Recitation Section (anal) Recitation				1	Tvn	Hrs/wk	CP
necess and Pant Engineering 11.00000 necessa and Pant Pant Pant Pant Pant Pant Pant Pant		095)					
Module Responsible Prof. Mirko Skibprowski Admission Requirements None Recommended Previous Integration of thermal an dmachanical separation processes Knowledge chemical reactor eingineering Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconciliation problems explain pid-diagrams Skills students are capable of - formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of process synthesis - economic evaluation of processes and the estimation of production costs Personal Competence Social Competence Autonomy Verkload In Hours To Smy Bowus Form Description Course achievement Computancy Bowus				F	Recitation Section (large)	1	2
Admission Requirements None Recommended Previous unit operation of thermal an dmechanical separation processes knowledge chemical reactor eingineering Educational Objective After taking part successfully, students have reached the following learning results Professional Competence	Process and Plant Engineering I (L1	214)		F	Recitation Section (small)	1	2
Recommended Previous Knowledge unit operation of thermal an dmechanical separation processes chemical reactor eingineering Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcililation problems explain linear regression and data reconcililation problems explain pfd-diagrams Skiffs students are capable of - formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of data reconcililation tasks - conduction of process synthesis - economic evaluation of processes and the estimation of production costs Personal Competence Social Competence Versionary 6 Course achievement Social Competence Versionary 5 Swiget Curret points 6 Ferm Caurse achievement Social competence Social c	Module Responsible	Prof. Mirko Skiborows	ki				
Knowledge After taking part successfully, students have reached the following learning results Professional Competence Students can: Knowledge students can: Construction classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes capial inter regression and data reconcilitation problems specify linear regression and data reconcilitation problems capial inter regression and data reconcilitation problems students are capable of component streams of chemical plants using linear component balance models capial inter component streams of chemical plants using linear component balance models solution of data reconcilitation tasks conduction of process synthesis conduction of process synthesis social Competence solution of process synthesis conduction of process synthesis Social Competence solution of subject theoretical and Social Competence Subject theoretical and Social Competence solution of ass Social Competence Subject theoretical and Remotent regineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory Social Competence Subject theoretical and Social Competence Subject theoretical and Rem	Admission Requirements	None					
Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence students can: Knowledge students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconciliation problems explain infed-diagrams Skills students are capable of - formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of data reconciliation tasks - conduction of process synthesis - economic evaluation of process synthesis - economic evaluation of processes and the estimation of production costs Personal Competence subject theoretical and particelow with subject sectors Course achievement scale General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program	Recommended Previous	unit operation of ther	mal an dmechanical se	paration processes			
Professional Competence Knowledge students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcilitation problems explain pld-diagrams Stills students are capable of -formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of data reconcilitation tasks - conduction of process synthesis - economic evaluation of processes and the estimation of production costs Personal Competence Social Competence Autonomy Workload in Hours Autonomy Workload in Hours Social Computery Bonus Form Description Yes 10 % Subject theoretical and practical work Examination Following Curricula General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Compulsory Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Electron Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy an Environmental Engineering: Electron Compulsory Gene	Knowledge	chemical reactor eing	jineering				
Professional Competence Knowledge Students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcililation problems explain pfd-diagrams Stills Stills students are capable of -formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of data reconcililation tasks - conduction of process synthesis - economic evaluation of processes and the estimation of production costs Personal Competence Social Competence Autonomy - economic evaluation of processes and the estimation of production costs Verkioad in Hours (mempersonal to be process synthesis - economic evaluation of processes and the estimation of production costs - economic evaluation of processes and the estimation of production costs Verkioad in Hours (autonomy Independent Study Time 124, Study Time in Lecture 56 Credit point (Secourse achievement Secial - formulation by Subject theoretical and practical work Examination Secial 120 Min. lectures notes and books scale - formulation process Engineering: Compulsory Bioprocess Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory Bioprocess Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Ele Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: C	Educational Objectives	After taking part succ	essfully, students have	reached the following	learning results		
Knowlede sidents can: classify and formulate biobal balance equations of chemical processes specify linear component equations of chemical processes classify and formulate biobal balance equations of chemical processes specify linear component equations of complex chemical processes classify and formulate biobal balance equations of chemical processes specify linear component balance equations and estimation of product streams formulation of mass and energy balance equations and estimation of product streams - solution of data recombination of product streams conduction of data recombilitation tasks - conduction of data recombilitation forduction costs formulation of not evaluation of production costs - conduction of processes and the estimation of production costs formulate - conduction of processes and the estimation of production costs formulate - conduction of processes and the estimation of production costs formulate - conduction of processes and the estimation of production costs formulate - conduction of processes and the estimation of production costs formulate - conduction of processes and the estimation of production costs formulate - conduction costs formulate - conduction costs formulate - conduction costs formulate - conduction cost		· · · · · · · · · · · · · · · · · · ·			,		
specify linear component equations of complex chemical processes explain linear regression and data reconcilitation problems explain pid-diagrams skills		students can:					
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Personal Competence - economic evaluation of processes and the estimation of production costs Social Competence - Autonomy - Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Credit points 6 Compulsory Form Victure Number of the operation of the operatis the operatis the operatis the operation of the operat							
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General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory		General Engineering	Science (English prog	gram, 7 semester):	Specialisation Energy and	l Enviromental E	ngineering: Elect
		Compulsory					
Green Technologies: Energy, Water, Climate: Specialisation Bioresource Technology: Elective Compulsory		General Engineering	Science (English progra	m, 7 semester): Speci	alisation Process Engineeri	ng: Compulsory	
Process Engineering: Core qualification: Compulsory					ource Technology: Elective	Compulsory	

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

l	Data reconciliation and data validation
	3. Process Synthesis
	Decision levels
	Experimental process development
	Reactor synthesis
	Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams)
	4. Process safety
	5. Cost estimation of production plants
	Production costs, capital costs, economic evaluation
Literature	S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679
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	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
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	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76
	F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

Course L0096: Process and F	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	rse 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		

Module M0891: Infor	matics for Process Engineers				
	hatics for Frocess Engineers				
Courses					
Title		Тур		Hrs/wk	СР
nformatics for Process Engineers (L0836)	Lecture		2	2
nformatics for Process Engineers (L0837)	Recitatio	n Section (small)	2	2
Numeric and Matlab (L0125)	1	Practical	Course	2	2
Module Responsible	Dr. Marcus Venzke				
Admission Requirements	None				
Recommended Previous	Basic knowledge in using MS Windows.				
Knowledge					
Educational Objectives	After taking part successfully, students have	ve reached the following learning	ng results		
Professional Competence					
Knowledge	Students can describe procedural and obje	ect-oriented concepts.			
Skills	Students are capable of object-oriented p	programming in the programing	n language lava ang	l of solving math	ematic questions
SKIIS	using Matlab.		g language java and	a or solving math	
	Students are capable of developing conception	pts (simple algorithms) to solve	technical questions		
Personal Competence					
Social Competence	Students are able to work out solutions too	gether in small groups.			
Autonomy	Students are able to assess acquired skills	by applying it in practice.			
Workload in Hours	Independent Study Time 96, Study Time in	n Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	General Engineering Science (English prog	gram, 7 semester): Specialisatio	n Process Engineeri	ng: Elective Com	oulsory
Following Curricula					
	Compulsory				

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

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

Course L0125: Numeric and	Matlab
Тур	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Siegfried Rump, Weitere Mitarbeiter
Language	DE
Cycle	SoSe
Content	 Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB
Literature	Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007
	 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005

Courses						
Title				Typ	Hrs/wk	СР
Computer Science for Engineers - P	Programming Concepts D	ata Handling & Communication	(12689)	Typ Lecture	BIS/WK	3
Computer Science for Engineers - P				Recitation Section (small)	2	3
Module Responsible	Prof. Sibylle Fröschle					
Admission Requirements	None					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part succe	essfully, students have reache	ed the followi	ng learning results		
Professional Competence		· ·				
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours		ne 110, Study Time in Lecture	e 70			
Credit points		F	B			
Course achievement	No 10 %		Description Testate finde	n semesterbegleitend statt.		
Examination		Attestation		in semester begiettenta statt.		
Examination duration and						
scale	120 mm					
	General Engineering	Science (German program,	7 semester	·)· Specialisation Mechanica	l Engineering F	ocus Biomechani
5	5 5	Science (Serman program,	7 Semester	. opecialisation meenamea	i Engliteering, i	bioincenam
3 • • • •		cience (German program, 7 s	emester): Sp	ecialisation Process Engineer	ing: Compulsory	
		cience (German program, 7 s				ory
	General Engineering S	cience (German program, 7 s	emester): Sp	ecialisation Green Technolog	ies, Focus Renew	able Energy: Elect
	Compulsory					
	General Engineering	Science (German program,	7 semester):	Specialisation Mechanical	Engineering, Foc	us Energy Syster
	Compulsory					
	General Engineering	Science (German program,	7 semester)	Specialisation Mechanical	Engineering, Foc	us Aircraft Syste
	Engineering: Compulso					
		Science (German program,	, 7 semeste	er): Specialisation Mechanic	al Engineering,	Focus Materials
	Engineering Sciences:		7	. Creatialization Machanics		
	Compulsory	Science (German program,	/ semeste): Specialisation Mechanica	ii Engineering, i	ocus mechatroni
		cience (German program, 7 s	omostor): Sr	ecialisation Mechanical Engli	peering Focus Th	eoretical Mechani
	Engineering: Compulso		Jennester). Sp	celuisation meenamear Engi	leening, rocus m	
		Science (German program, 7 :	semester): S	pecialisation Mechanical Eng	ineerina. Focus P	roduct Developm
	and Production: Electiv			<u>.</u>	<u>,</u>	
		cience (German program, 7 s	emester): Sp	ecialisation Electrical Enginee	ering: Elective Co	mpulsory
	Bioprocess Engineering	g: Core qualification: Compuls	sory			
	Electrical Engineering:	Core qualification: Compulso	ory			
	Energy and Environme	ental Engineering: Core qualifi	ication: Comp	oulsory		
	General Engineering S	cience (English program, 7 se	emester): Spe	cialisation Process Engineeri	ng: Elective Comp	oulsory
		Science (English program,	7 semester)	Specialisation Energy and	Enviromental E	ngineering: Elect
	Compulsory					
	-	nergy, Water, Climate: Specia		gy Systems: Elective Compul	sory	
		Core qualification: Compulso		maulaan		
	- ,	Specialisation Information Te	cnnology: Co	mpulsory		
		alification: Compulsory Core qualification: Compulsory	,			

Course L2689: Computer Science for Engineers - Programming Concepts, Data Handling & Communication			
Тур	Lecture		
Hrs/wk	3		
CP	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Sibylle Fröschle		
Language	DE		
Cycle	SoSe		
Content			
Literature	John V. Guttag: Introduction to Computation and Programming Using Python.		
	With Application to Understanding Data. 2nd Edition. The MIT Press, 2016.		

Course L2690: Computer Science for Engineers - Programming Concepts, Data Handling & Communication		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Sibylle Fröschle	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
ïtle		Тур	Hrs/wk	СР
lanagement Tutorial (L0882)		Recitation Section (small)	2	3
ntroduction to Management (L0880))	Lecture	3	3
Module Responsible	Prof. Christoph Ihl			
Admission Requirements	None			
Recommended Previous	Basic Knowledge of Mathematics and Business			
Knowledge	<u> </u>			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence Knowledge	After taking this module, students know the important ba and Organisation to Marketing and Innovation, and also to			
Skills	 explain the differences between Economics and important definitions from the field of Management explain the most important aspects of and goals i projects describe and explain basic business functions a organization and human ressource management, ir explain the relevance of planning and decision uncertainty, and explain some basic methods from state basics from accounting and costing and selec Students are able to analyse business units with respect 1 out an Entrepreneurship project in a team. In particular, the analyse Management goals and structure them apper analyse organisational and staff structures of comperative analyse production and procurement systems and le analyse and apply basic methods from mathematical apply basic methods from accounting, costing and select 	n Management and name the most s production, procurement and su information management, innovation making in Business, esp. in situa mathematical Finance ted controlling methods. to different criteria (organization, ot ney are able to propriately anies objectives, under uncertainty and ur Business information systems finance to predefined problems	t important aspe burcing, supply management ar tions under mul	cts of entreprneu chain manageme nd marketing tiple objectives a
	Students are able to work successfully in a team of students to apply their knowledge from the lecture to an ent to communicate appropriately and to cooperate respectfully with their fellow students. Students are able to work in a team and to organize the team themselve to write a report on their project.		oherent report or	the project
	<u> </u>			
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
	Subject theoretical and practical work			
Examination duration and scale	several written exams during the semester			
	General Engineering Science (German program, 7 semest	or), Coro qualification, Compulson		
Following Curricula	Civil- and Environmental Engineering: Specialisation Civil I Civil- and Environmental Engineering: Specialisation Wate Civil- and Environmental Engineering: Specialisation Traffi Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste General Engineering Science (English program, 7 semeste	r and Environment: Elective Compul c and Mobility: Elective Compulsory : Compulsory r): Specialisation Electrical Engineer r): Specialisation Civil Engineering: r): Specialisation Bioprocess Engine	ing: Compulsory Compulsory ering: Compulsor	ŷ

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

382: Management Tutorial
Recitation Section (small)
2
3
Independent Study Time 62, Study Time in Lecture 28
Prof. Christoph Ihl, Katharina Roedelius
DE
WiSe/SoSe
In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools.
If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on so 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.

T	Lastura			
	Lecture			
Hrs/wk				
СР	3			
	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Corneli			
	Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona			
Language	DE			
	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, Innoval 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. A Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008.			

	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	
Professional Competence	After taking part successfully, students have reached the following learning results
Knowledge Skills	 The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their 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. 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	12
Course achievement	None
Examination	Thesis
Examination duration and	According to General Regulations
scale Assignment for the Following Curricula	General Engineering Science (German program): Thesis: Compulsory General Engineering Science (German program, 7 semester): Thesis: Compulsory Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Data Science: Thesis: Compulsory
	Digital Mechanical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory Engineering Science: Thesis: Compulsory General Engineering Science (English program, 7 semester): Thesis: Compulsory Green Technologies: Energy, Water, Climate: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechatronics: Thesis: Compulsory Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory Technomathematics: Thesis: Compulsory Teilstudiengang Lehramt Elektrotechnik-Informationstechnik: Thesis: Compulsory Process Engineering: Thesis: Compulsory